

***Final Draft
Remedial Investigation/
Feasibility Study Work Plan
Former Pacific Powder Site
Maytown, Washington***

***Prepared for
Citifor, Inc.***

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

FORMER PACIFIC POWDER SITE

MAYTOWN, WASHINGTON

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan describes proposed field investigation tasks that will be used to characterize environmental conditions at the Former Pacific Powder site. The Former Pacific Powder site is located near Maytown, Washington (see Figure 1-1 for location). The RI/FS will be conducted pursuant to an Agreed Order to be negotiated with the Washington State Department of Ecology (Ecology).

This Work Plan (Plan) has been developed in accordance with WAC 173-340-350. A preliminary Remedial Investigation/Feasibility Study Scoping Plan (dated September 11, 2003) was developed by Hart Crowser and submitted for Ecology review. Ecology issued written comments to the Scoping Plan on December 11, 2003, and they were discussed at a meeting held at Ecology's Southwest Regional office on December 15, 2003. Results of these discussions were used to develop this Plan. Written responses to Ecology's comments are presented in Appendix A.

This Plan consists of four sections:

- **1.0 PROJECT OVERVIEW** describes the project background, objectives, scope of work elements, and organization.
- **2.0 SAMPLING AND ANALYSIS PLAN** provides an overview of the rationale and methods to be used for the RI sampling and analysis. The intent of this sampling and analysis program is to define the nature and extent of contamination for the purpose of developing and evaluating cleanup action alternatives under the Washington State Model Toxics Control Act (MTCA).
- **3.0 QUALITY ASSURANCE PROJECT PLAN** presents the general and specific steps to be taken throughout the course of this program to ensure that the data satisfy minimum quality assurance requirements and are scientifically defensible.
- **4.0 HEALTH AND SAFETY PLAN** addresses procedures to minimize chemical exposure risks and to prevent physical accidents for on-site workers. The plan includes sections on site hazards, levels of protection, work zones, personnel and equipment decontamination, emergency facilities, and chemical exposure systems.

These sections are supported by tables and figures which are numbered according to and presented at the end of, their respective sections except for Section 4, where tables and figures are inserted throughout the text. Further, the report contains three appendices, titled:

- Appendix A - Response to Ecology Comments on Remedial Investigation/ Feasibility Study Scoping Plan;
- Appendix B - STL Laboratory Quality Control Criteria; and
- Appendix C - Explosive Hazard Assessment (EHA).

1.0 PROJECT OVERVIEW

1.1 Introduction

1.1.1 Site Description

The approximately 1,625-acre subject property is located east of Tilley Road approximately 2 miles east of Maytown (Figure 1-1). The property is generally flat, with hillsides located on the northern and southern edges. The majority of the property is undeveloped and covered by brush and woodlands (Figure 1-2). Beaver Creek, running east to west along the southern end of the property, is surrounded by wetlands. A smaller creek (Allen Creek) drains the northwest portion of the property.

A small portion of the property was occupied by a dynamite manufacturing plant from the early 1940s until 1968. For the majority of its operational history (approximately 1942 through 1964), the former Pacific Powder plant (Powder Plant) was limited to the north central portion of the property and consisted of less than 100 acres of land and leased magazine space from adjacent property owners (Figure 1-1). In 1965, the Hercules Powder Company (Hercules) purchased approximately 1,600 acres of land surrounding the plant. However, manufacturing activities remained limited to the north central 100-acre portion of the property. From the late 1960s until 1994, Ammonium Nitrate Fuel Oil (ANFO - a mixture of ammonium nitrate and fuel oil) and slurry explosives were manufactured within the Powder Plant and Monoethanolamine Nitrate (MEAN) plant areas. A culvert production facility (Culvert Plant) located west of the Powder Plant Area operated from approximately 1976 through the mid-1980s.

Many buildings located in the areas identified on Figure 1-1 as the Powder Plant and Culvert Plant are still present and are typically constructed of metal with concrete foundations (some wood and brick structures are also present). Most of the buildings located in the Old and New Nitrator areas, the MEAN Plant, labs, and various powder line buildings (e.g., dynamite and gelatin houses) have been demolished and are overgrown with dense brush (Scotch Broom). Very little evidence (e.g., foundations, demolition debris) of these former structures is currently visible. Woodlands, scattered residential homes, and pastures surround the property. The Tacoma Western Railway right of way crosses the north end of the property.

1.1.2 Historical Land Use

Figures 1-3 through 1-5 show known site features as they existed during the approximate time period identified on the figures.

The Pacific Powder Company (Pacific Powder I) plant was built in the early 1940s to produce dynamite. At that time, a farmhouse and associated farm buildings appear on the property near Tilley Road. The plant property was approximately 100 acres in area prior to 1964. The plant had one dynamite production line throughout this period. The plant included the Powder Plant (at least 15 separate structures), a nitrator (identified as the Old Nitrator Area on Figure 1-3), mix and neutralizer houses, dynamite and gelatin houses, box and case pack houses, DNT melting house (exact location currently unknown), a laboratory (identified as EGD Lab on Figure 1-3), and a burn pit (identified as Pacific Powder I [PPI] Burn Pit on Figure 1-3). A narrow gauge railroad was used to transport materials across much of the plant area. Batches of nitroglycerin reportedly moved by gravity flow through a gutter system from the Nitrator House to the Neutralizer House. Rubber-tired buggies were used for the transport of nitroglycerin from the Neutralizer House to the Mix House.

Four magazines reportedly constructed of wood were used to store finished products in areas leased from adjacent property owners (identified as Magazines 1, 2, 3, and 4 on Figure 1-1). Other buildings on the site, consisting of at least one earthen covered Quonset hut and small block houses, were used to store detonators that were manufactured elsewhere and stored. A relatively small bermed area northwest of Magazine 1 was originally identified as Magazine 2 in the Hart Crowser Phase I report produced in February of 2003. However, a schematic drawing (not to scale) produced by Dyno Nobel indicated that a magazine was located in the southeastern corner of the property as depicted on Figure 1-1. Review of aerial photographs indicate that a structure was present in this area. A March 26, 2004, interview and site visit conducted with Ken Dunkin, a current Alaska Pacific Powder Company (APPCO) employee who worked at the site from 1983 to 1994, indicated that the Magazine 2 location was used for detonator storage.

In 1964, Hercules purchased the property from Pacific Powder I, and continued to manufacture dynamite. Hercules purchased surrounding land that increased the property to the present size of approximately 1,625 acres, but the vast majority of this additional land was not used in the manufacturing process nor otherwise developed. Manufacturing activities remained primarily within the north central 100-acre portion of the property. By 1965, Hercules had constructed a square-fenced burn pit southeast of the Pacific Powder I Burn Pit

(identified as 1960s-Era Hercules Burn Pit on Figure 1-4) and a laboratory located northwest of the Mix House (Figure 1-4). By 1968, the Hercules plant included a new nitrator facility (identified as New Nitrator Area on Figure 1-4) located approximately 600 feet south of the Old Nitrator Area. Acid and glycol tanks were constructed approximately 400 feet west of the New Nitrator Area. In the late 1960s, a plant later known as the MEAN Plant was constructed for production of ANFO. A standard gauge railroad spur was also constructed to serve the MEAN Plant. Hercules closed the dynamite plant in 1968.

In approximately 1969, former Hercules salesman William Garson incorporated Pacific Powder Pipe & Supply, Inc. (designated in this report as PPP&S) and leased the property from Hercules in 1970. PPP&S later became known as PACCO. In the late 1970s to the mid-1980s, ANFO production was moved to the large building in the Powder Plant Area (Building 9 shown on Figure 1-5). After ANFO production was moved, MEAN (a slurry explosive) was manufactured at the MEAN Plant. According to a September 7, 1993, memorandum issued by Dyno employee Dale Patton, MEAN Plant operations were discontinued in 1985 or 1986. Production of ANFO within the Powder Plant Area continued until approximately 1993.

By 1970, the 1960s-Era Hercules Burn Pit was no longer in use and was covered with grass. However, disturbed soil is visible in historical aerial photographs east of the Pacific Powder I Burn Pit in areas later identified as the Drum Burial Area and Alleged Burial Site (ABS) Landfill (Figure 1-5). The ABS Landfill area includes a landfill/burn area that was reportedly used for disposal of garbage during the 1970s and 1980s. The 1977 aerial photo shows two newer burning grounds located 1,200 feet east of the MEAN Plant (identified as the 1970s-Era Fireworks Burn Pits on Figure 1-5). One of the burning grounds was reportedly used by law enforcement agencies for destruction of contraband fireworks.

A Culvert Plant was located 1,500 feet east of the Former Hercules Office (Caretaker Residence on Figure 1-1) and operated from approximately 1976 through the mid-1980s. This operation was owned by PPP&S but was not directly related to the explosives plant. However, some tanker trucks used the Culvert Plant area for parking. Treated steel culvert was manufactured by rolling and welding steel in the building identified as Warehouse on Figure 1-5, and dipping the steel culverts in asphalt/tar in the Dipping Building.

Hercules sold the subject property to Ireco, Inc. (the predecessor of Dyno Nobel, Inc.) in May 1985. According to a 1994 environmental cleanup report prepared by Dyno Nobel (Dyno Nobel 1994), Ireco purchased PPP&S in 1988. Dyno Nobel (Dyno) sold the property to Citifor Inc. in 1993. Dyno's 1994

report indicates that it leased a portion of the property from Citifor for one year and sub-leased it to its distributor (Alaska Pacific Powder Company [APPCO]). Dyno decommissioned the plant in late 1994.

When Citifor purchased the property in 1993, Dyno conducted an environmental investigation and cleanup program. Details of Dyno's cleanup activities are discussed in Section 1.2. Following purchase of the property, Citifor logged the site in preparation for redevelopment. During clearing operations in late 1997, buried drums were encountered at the Drum Burial Area. Excavation and cleanup activities conducted in the Drum Burial Area are discussed in Section 1.2.

Some details of the historical land use interpretation may change based on review of records that may be obtained from Dyno Nobel or other parties in response to Ecology information requests. Any changes will be incorporated into the final Work Plan.

1.2 Previous Environmental Investigations

Several environmental investigations and cleanup actions have been conducted on the site since the late 1980s.

Culvert Plant, 1989. Liquid storage drums had leaked oil through a trailer floor and onto soil in an area of about 330 square feet at the Culvert Plant. The soil contained "non-hazardous" motor oil, hydraulic oil, and mineral spirits. Sweet Edwards/EMCON removed soils with petroleum odors within a 22- by 15-foot area (Sweet Edwards/EMCON 1989). Some verification samples collected in May 1989 had concentrations of total petroleum hydrocarbons (TPH) ranging from 600 to 3,000 mg/kg. Three test pits were excavated in June 1989. Sampling and analysis indicated that TPH contamination in soil attenuated rapidly with depth. Additional soil was excavated to depths of 8 to 12 feet below ground surface. Verification soil samples collected along the side walls and bottom of the excavation did not contain TPH concentrations in excess of 200 mg/kg. Final cleanup documentation was submitted to Mr. Paul Sonnenfeld of Ecology in a letter dated November 21, 1989.

Powder Plant UST Removal, 1989. Three underground storage tanks (USTs) were decommissioned and removed from the Powder Plant area in 1989 by Joe Hall Construction. Two of the tanks were old railroad tank cars used to store diesel and were located south of the main plant building (Figure 1-5). The third tank was a 2,000-gallon gasoline UST located in the northeastern corner of the Powder Plant Area. Over 1,400 cubic yards of petroleum-impacted soils were

removed from the tank excavations. According to a September 20, 1989, letter from Pacco to Mr. Dick Walker of Ecology, final verification samples collected from the side walls and bottoms of the excavations contained TPH concentrations of less than 30 mg/kg.

Dyno Nobel Site Wide Cleanup, 1990 to 1995. Twenty-nine “environmental units” were identified and investigated by Dyno. Many of these units were located in the Powder Plant Area. Results of Dyno’s investigations and cleanup actions were summarized in two reports (Campbell and Dunkin 1994 and Dunkin 1995). Dyno encountered and removed thousands of cubic yards of petroleum-impacted soils adjacent to Powder Plant area sumps, tanks, oil/water separators, drain oil pits, a wood basin near the Truck/Diesel Shop (Building 13), and a diesel line trench at the Diesel AST (Building 20).

TPH-impacted soils were also encountered and removed from the Culvert Plant and the ABS Landfill Area (located just southeast of the Drum Burial Area). The Culvert Plant cleanup included removal of petroleum-impacted soil around the “dipping plant.” Some soil was also removed from a stormwater culvert outfall south of the Culvert Plant. Based on the analytical data collected by Dyno, their cleanup activities were successful at removing petroleum-impacted soils at the ABS Landfill. However, elevated metals concentrations were also detected in several soil samples, including cadmium (up to 4.3 mg/kg) and lead (up to 670 mg/kg). Surveyed locations of these soil samples were not provided in the 1995 report.

A large volume of diesel-impacted soil was also excavated at the MEAN Plant. Although soil volume calculations were not provided in the report, excavation maps and verification soil sample analytical results indicate that the diesel contamination was present to depths of up to 27 feet below ground surface. Dyno’s consultant (Conrex) installed three monitoring wells at locations surrounding the area of petroleum-impacted soil. No diesel-range hydrocarbons were detected in groundwater samples collected from these wells. The soil excavated at the MEAN Plant was bioremediated on site by Olympic Environmental.

Dyno also evaluated environmental conditions in two areas located southeast of Magazine 3 identified as the Farm House Burn Pit and Seismic Pond (Figure 1-5). Burned caps and copper wire were encountered in a small (10- by 10- by 4-foot) pit located next to the old farmhouse site. Dyno stated in its 1994 cleanup report that although it appeared that old electronic detonators were burned in the pit, excavation and testing activities did not encounter “hazardous contaminants.” Dyno’s 1994 cleanup report mentioned the presence of a

seismic pond that was used for testing the quality and reliability of explosives manufactured at the Pacific Powder plant. The exact location and size of the pond were not presented in the report but Dyno's schematic diagram indicated that it was present in the general area northwest of the Farm House Burn Pit (Figure 1-5). Ken Dunkin of APPCO indicated that the Seismic Pond consisted of a small semi-circular depression located at the edge of the wetland area. Ken stated that sediment at the bottom of the pond was removed and disposed of off site during cleanup. Dyno's reports stated that the Seismic Pond area was clean, and that soil was being graded away from a wetland.

As part of the cleanup program, Dyno demolished four magazines by burning them in accordance with procedures negotiated with the Olympic Air Pollution Control Authority and the Little Rock Fire Department. Dyno reported that the magazines were constructed with wood flooring and walls (according to Ken Dunkin, Magazine 1 had concrete flooring). Following the demolition burning of the magazines, a composite sample of the residual burned ash material was tested for metals and contained only 23 mg/kg of lead. The ash material was disposed of at an off-site facility.

Dyno's reports also indicated that in August 1990, the property's five transformers were tested for PCB content. Samples of oil from two transformers at the MEAN Plant contained 219 and 636 ppm PCB. The oil in these transformers was drained and replaced with non-PCB-containing oil.

Well Water Testing, 1996 to 1997. Under contract to George Heidgerken, Robinson and Nobel sampled nine of ten wells for conventional parameters (e.g., alkalinity, hardness, nitrate, and conductivity) on the property and evaluated pumping rates (Robinson and Nobel 1996). High chloride and mineralization were detected in the eastern wells. "Good" water quality was reported on the downgradient western side, though Well PP#4 had a pH of 5.5 and Wells PP#1 and PP#3 had pH measurements of 6. Wells PP#7 and PP#8, located east and southeast of the plant (Figure 1-5), had "low quality water" with elevated chloride and minerals (high conductivity). Well PP#5, located within the Powder Plant area, had very high chloride (similar to seawater levels), 10 percent dissolved solids, and contained oily/waxy "blobs."

Pacific Groundwater Group (PGG) performed an evaluation of groundwater quality in the vicinity of well PP#5 (Pacific Groundwater Group 1997). In July of 1997, PGG performed a slug test in the well and determined that it was not in good hydraulic continuity with the aquifer. The bottom of the well was also apparently plugged by fine black sediment. PGG concluded that this finding was consistent with PP#5's reported use as a grounding well rather than a supply

well. Lightning rod grounding wells are treated with salt to increase electrical conductivity to attract lightning away from nearby buildings.

To verify that the elevated chloride and dissolved solids concentrations were limited to water within the PP#5 casing, PPG monitored conductivity in water samples collected at 5-foot-depth intervals within a boring installed adjacent to the grounding well. Conductivity readings in groundwater adjacent to PP#5 were similar to other areas within the Pacific Powder property and did not appear to contain salt.

Conrex/AETS Drum Burial Area Waste Characterization, 1997 to 1998. During logging operations in late 1997, buried drums were encountered at the Drum Burial Area (Figures 1-1 and 1-6). In early 1998 Conrex, under contract with Dyno, performed a site investigation to identify drum burial locations and define the nature and extent of soil contamination resulting from the buried drums. The first phase of the investigation included a magnetometer survey within three 200-foot diameter circles around locations of drums exposed during logging. Each location where a magnetic anomaly was recorded (indicating presence of ferrous metal) was excavated by hand to determine if drums were present. Confirmed locations of drums were marked for excavation. Some drums were labeled dinitrotoluene (DNT) and three appeared to contain residual DNT. Drums were excavated from the upper 2 feet of soil in three areas identified as Excavations 1, 2, and 3 on Figure 1-6. Soil in the area was contaminated with nitroaromatic compounds including DNT. Contaminated soil was stockpiled southwest of the excavations.

In April 1998, AETS, currently doing business as ONYX, was contracted to assist Dyno with additional drum and soil removal and to transport contaminated drums off site for proper disposal. AETS began trenching in the vicinity of previous excavations and discovered more drums buried north of Excavation 3. This new buried drum location is identified as Excavation 3A on Figure 1-6. AETS removed drums as they were discovered, collected soil samples from some of the trenches and excavations, and submitted the samples for analysis of nitroamine/nitroaromatic compounds (EPA Method 8330). Constituents of concern identified in site soils included isomers of DNT, trinitrotoluene (TNT), and nitrotoluene. The isomers of DNT, specifically 2,4-DNT and 2,6-DNT, were the most commonly detected compounds at the site. For the purpose of this RI/FS Work Plan, total DNT is defined as the sum of the 2,4-DNT and 2,6-DNT concentrations.

Based on the results of analysis, additional excavation was performed in Excavations 1, 2, 3, and 3A, and the soil was stockpiled on site. AETS packaged

and transported most of the drums and associated debris for off-site disposal before it stopped work in late 1998 or early 1999.

Thurston County Health Department Review, 1998. In response to the discovery of buried drums on site, six surrounding area drinking water wells were sampled and analyzed by Ecology and Thurston County Health Department in 1998. Groundwater samples collected from the wells were analyzed for volatile and semivolatile organics, nitroaromatics and nitroamines, metals, and nitrate/nitrite. Sample analytical results for the wells were acceptable based on drinking water standards except for two wells located on 143rd Street that contained pentachlorophenol (PCP or penta) above state and federal drinking water standards. The six wells, plus ten other area wells, were then resampled. None of the sixteen wells contained penta. The two wells where penta had been detected were resampled a third time, and again no penta was detected. Ecology and Thurston County Health Department concluded that the groundwater from the wells was safe to drink.

Hart Crowser Drum Burial Area Investigations, 1999 to 2003. Hart Crowser became involved with the Drum Burial Area in August 1999 under contract to Citifor and completed the following tasks:

- Covered the soil stockpiles with heavy plastic and placed a plastic liner in Excavation 3 (December 1999);
- Assisted Citifor in transporting remaining drums and debris from the site through a contract with AETS (October through December 1999);
- Collected and analyzed soil samples from excavations and trenches not previously sampled by AETS to fill data gaps (October 1999);
- Completed a cleanup action objective and focused feasibility study (Hart Crowser 2000);
- Installed four groundwater monitoring wells (June 2000);
- Completed four rounds of quarterly groundwater monitoring in June and October of 2000 and January and May of 2001 (Hart Crowser 2001); and
- Collected soil samples from Excavation 3 for total and TCLP analysis of DNT (October 2002).

Only one of the 26 soil samples submitted for chemical analysis from Excavations 1 and 2 contained detectable concentrations of DNT. Trench sample HC-EX1-T6 collected within the Excavation 1 area contained a total DNT concentration of 0.68 mg/kg. No soil samples collected from Excavation 2 contained detectable DNT concentrations. Relatively low concentrations (less than 0.7 mg/kg) of total DNT were detected in the Excavation 3 samples.

The first of the four rounds of groundwater sampling, which occurred in June 2000, encompassed a comprehensive suite of chemical parameters, including:

- Nitroaromatics/Nitroamines (EPA Method 8330);
- Dissolved Metals (arsenic, cadmium, chromium, copper, mercury, lead, nickel, and zinc);
- Total Petroleum Hydrocarbons (TPH - WTPH-G and D-extended);
- Volatile Organic Compounds (EPA Method 8260);
- Semivolatile Organic Compounds (EPA Method 8270); and
- Miscellaneous Inorganics (nitrate, ammonia, sodium chloride, sulfate, and total suspended solids).

Since chemical analytes were not detected above concentrations of concern during the first round of monitoring, the parameter list was reduced to nitroaromatics/nitroamines during subsequent sampling rounds (Hart Crowser 2001). No nitroaromatic/nitroamine compounds were detected in the June 2000 or October 2000 groundwater sampling rounds. In January 2001, well HC-MW-3 contained an estimated concentration of 7 ug/L total DNT. In May 2001, a sample from well HC-MW-3 contained 1.07 ug/L total DNT.

Hart Crowser completed a supplemental field investigation within the Drum Burial Area in 2002. Results of this investigation are summarized in a Hart Crowser letter report dated February 18, 2003. The primary objectives of this field investigation were to better define the extent of DNT in site groundwater and identify potential soil source areas (if any). As part of this task, 11 borings were advanced across the site using a direct-push drilling rig. One grab groundwater sample was collected at each boring location in July 2002. Groundwater was typically encountered at the site at depths of 15 to 16 feet below ground surface. Groundwater samples were also collected from the four permanent wells located within the Drum Burial Area (Figure 1-6). Groundwater samples were submitted for chemical analysis of nitroaromatics and nitroamines (EPA Method 8330), dissolved iron and manganese (to better define redox conditions), and total suspended solids (TSS).

DNT concentrations detected in Drum Burial Area groundwater were typically very low in the July 2002 sampling event. Only 3 of the 15 sampling locations contained detectable concentrations of DNT. Detected total DNT concentrations ranged from 0.0967 to 0.274 ug/L.

Once the groundwater sampling program was completed, Hart Crowser excavated 12 test pits around Excavation 3 and four locations in the Excavation 1 area. Soil sample analytical results obtained during this investigation confirmed that elevated concentrations of total DNT (less than 0.7 mg/kg) are present only within Trench 6 in the Excavation 1 area (Figure 1-6). Based on the lack of DNT in the seven other trench samples collected within Excavation 1, the occurrence of DNT in Excavation 1 appears to be limited in extent to the Trench 6 area.

An elevated concentration of DNT was also encountered in soils located along the eastern boundary of Excavation 3. Although total DNT at this sampling location was only reported at a concentration of 0.351 mg/kg, the relatively high toxicity characteristic leaching procedure (TCLP) DNT leachate concentration associated with the sample (98 to 190 ug/L) indicates that a greater amount of total DNT may be present. Given that DNT was only detected in one of the 32 samples collected within Excavation 3 during the 2002 sampling event, it appears that the DNT occurrence along the eastern boundary of Excavation 3 is relatively isolated.

Hart Crowser Site Wide Phase II Environmental Assessment, 2002 to 2003. A Phase II environmental assessment was conducted by Hart Crowser to evaluate environmental conditions on the Former Pacific Powder site (dated February 24, 2003). The field assessment focused primarily on evaluating groundwater quality beneath potentially impacted areas. As part of this investigation, 21 monitoring wells were installed at the following locations between November 18 and November 27, 2002:

- MEAN Plant (MP-MW1, MP-MW2, and MP-MW3);
- Powder Plant (PP-MW1, PP-MW2, PP-MW3, PP-MW4, PP-MW5, and PP-MW6);
- Old Nitrator Area (ON-MW1, ON-MW2, and ON-MW3);
- New Nitrator Area (NN-MW1, NN-MW2, NN-MW3, and NN-MW4);
- Mix House and Neutralizer House (MH-MW1 and NH-MW1, respectively);
- Culvert Plant (CY-MW1 and CY-MW2); and
- ABS Landfill (ABS-MW1).

Depending on the past history of the area of concern, the wells were sampled and analyzed for constituents of potential concern including TPH, volatile organics (VOAs), inorganics (including nitrate, ammonia, sulfate, sodium and chloride), glycols, nitroglycerin, nitroaromatics-nitroamines (NA/NA including DNT), semivolatile organics (SVOAs), pH, and metals. Two of the wells (PP-MW1 and PP-MW4) within the Powder Plant area were dry and could not be sampled.

Surface soil sampling was performed in areas where burning activities or heavy metal-containing herbicide applications (if performed) could have occurred (e.g., magazine sites). Surface soil samples were collected at the locations of the former Lab, Magazines, and Dynamite and Gelatin Houses, as well as at a depression in the Culvert Plant. Surface soil samples were generally analyzed for metals (except for Culvert Plant sample). Selected samples were also analyzed for NA/NA and SVOAs.

Results of the Phase II investigation indicated that site groundwater quality does not appear to be significantly impacted. No NA/NA, nitroglycerin, perchlorates, SVOAs, or VOAs (except for the probable lab contaminant methylene chloride) were detected in any of the 19 groundwater samples analyzed. The wells were placed in the inferred downgradient areas of identified explosives and culvert manufacturing areas. Diesel-range TPH was identified in groundwater in two locations: Powder Plant well PP-MW6, and MEAN Plant well MP-MW1. However, both TPH concentrations were below the Model Toxics Control Act (MTCA) Method A groundwater cleanup level of 0.5 mg/L.

Metals and conventional inorganic analytes were generally not detected at concentrations of potential concern. High concentrations of sulfate reported for samples collected at the Old and New Nitrator areas were considered suspect and were not verified in subsequent investigation (see **Groundwater Sulfate Sampling** section below).

Surface soil samples generally did not contain constituents at concentrations exceeding background conditions or MTCA cleanup levels. The concentration of diesel- and oil-range petroleum hydrocarbons in a surface soil sample collected at the Culvert Plant drainage depression exceeded Method A unrestricted cleanup levels. Arsenic concentrations in two of the 37 soil samples collected slightly exceeded the Method A unrestricted cleanup level. Detected lead concentrations ranged from 4 to 62 mg/kg, well below the Method A unrestricted cleanup level of 250 mg/kg and the MTCA ecological indicator soil concentration of 118 mg/kg.

Groundwater Sulfate Sampling within the Nitrator Areas, 2002 - 2003. During the Phase II groundwater sampling event (December 2002), elevated concentrations of sulfate (2,550 to 3,870 mg/L) were reported in groundwater samples collected from the Old and New Nitrator areas. These reported sulfate concentrations greatly exceeded concentrations (3.1 to 10.2 mg/L) encountered in other areas of the site during the Phase II investigation.

The reported sulfate concentrations in the Old and New Nitrator areas were inconsistent with other site data and were considered suspect. Although elevated sulfate concentrations could be caused by releases of sulfuric acid that were historically discharged to the Old Nitrator acid pond along with nitric acid, no other evidence of acid impacts was observed in the groundwater samples. Field measurements of pH for Old and New Nitrator groundwater samples ranged from 6.4 to 7.0 and were similar to values measured in other portions of the site. In addition, nitrate concentrations (which ranged from 0.5 to 1.4 mg/L) observed in the Old and New Nitrator area groundwater samples were not significantly elevated relative to other areas of the site and did not indicate a major release of nitric acid. It was suggested in the Phase II report that the elevated concentrations reported for sulfate in the Old and New Nitrator areas may be the result of laboratory error. Groundwater samples from the two areas were analyzed within the same laboratory batch and contained similarly high sulfate concentrations.

To evaluate whether previously reported groundwater sulfate concentrations for Old and New Nitrator wells were valid, three Old Nitrator wells (including ON-MW1, ON-MW2, and ON-MW3) and four New Nitrator wells (including NN-MW1, NN-MW2, NN-MW3, and NN-MW4) were resampled on March 31, 2003. Replicate groundwater samples were collected from each of the monitoring wells to allow samples to be submitted to two separate laboratories. One set of samples was sent to Severn Trent Laboratories (STL) in Tacoma, Washington, for analysis of sulfates using EPA Method 300A. STL performed the chemical analysis for sulfates during the Phase II investigation. The second set of samples was submitted to Analytical Resources Inc. (ARI) of Tukwila, Washington, for analysis of sulfates using EPA Method 375.2.

Sulfate concentrations observed in Old and New Nitrator groundwater samples during this second sampling event were much lower than the Phase II sample analytical results. Sulfate concentrations reported by both STL and ARI laboratories are fairly consistent (relative percent differences range from 6 to 36 percent) and are at least two orders of magnitude below the initial Phase II results. The highest sulfate concentrations were encountered in wells ON-MW1 (16.8 mg/L) and ON-MW2 (21.9 mg/L), which are both located downgradient of

the acid pond at the Old Nitrator. Concentrations of sulfate (4.3 to 7.2 mg/L) observed in the remaining wells within the Old and New Nitrator areas were similar to concentrations (3 to 10.2 mg/L) encountered in other portions of the site and to background concentrations for the southern Puget Sound area.

Aspect Consulting Soil Quality Characterization: Northeast Corner of Former Pacific Powder Property, 2004. Fifteen discrete surface soil samples were collected in January of 2004 to evaluate soil quality within a 72-acre area located in the northeast corner of the property. Ecology was concerned that this area may have been impacted by aerial deposition of particulates released by burning structures during the explosives plant decommissioning as well as possible site-wide use of arsenical herbicides.

Soil quality data obtained during this investigation indicate that the northeastern corner of the property has not been adversely impacted by release of metals from the former explosives manufacturing plant. Detected arsenic and lead concentrations in the soil samples ranged from 4 to 9 mg/kg and 4 to 13 mg/kg, respectively. The detected concentrations are within the range of Puget Sound natural background concentrations (as defined in Ecology's Natural Background Soil Metals Concentrations in Washington State, October 1994) and are below MTCA Method A soil cleanup levels for unrestricted land use for arsenic (20 mg/kg) and lead (250 mg/kg). The concentrations are also below MTCA ecological indicator soil concentrations for the protection of terrestrial wildlife (132 mg/kg and 118 mg/kg for arsenic and lead, respectively). Based on their review of the data, Ecology concluded that this portion of the property has not been adversely impacted and therefore no cleanup action is needed (letter from Mike Blum dated February 20, 2004).

1.3 Hydrogeologic Conditions

The uppermost geologic layers at the property are Vashon Drift containing, from youngest to oldest, recessional outwash, till, and advance outwash deposits. The Vashon recessional outwash typically contains unconsolidated sand, gravel, and cobbles, and has a high hydraulic conductivity. The till underlying the outwash is a very dense, gravelly, silty Sand and clayey, sandy Silt and typically is encountered 20 to 30 feet below grade at the property. However, the till is present at ground surface on the hills on the north side of the tracks. The thickness of the Vashon till varies from 0 to 17 feet across the central portion of the site. Penultimate glacial deposits (predating the Vashon deposits) are also present. The total thickness of glacial deposits in the outwash channel is estimated to range up to 130 feet.

Soils encountered during drilling of the Phase II monitoring wells typically included 1 to 4 feet of gravelly sand underlain by sandy gravel and cobbles to a depth of approximately 20 feet. Three borings (PP-MW1, PP-MW2, and PP-MW6) in the Power Plant Area were advanced to 24 to 30 feet below grade. In these borings, gravelly clayey silt was observed between depths of approximately 20 to 30 feet.

Groundwater elevations measured during the December 2002 sampling event indicate that groundwater flow is generally east to west (Figure 1-7). Depth to groundwater during sampling was typically 15 to 20 feet below grade. Groundwater flow directions observed during this Phase II sampling event are consistent with results previously reported by PGG. PGG determined that groundwater flow in June of 2002 was generally to the west along the southern half of the property, to the southwest in the northeastern corner, and to the northwest along the northwestern portion of the property.

1.4 Objectives

The objective of this RI/FS is to provide sufficient information, in combination with existing characterization information, to complete an evaluation of remedial alternatives for the site. To this end, specific objectives are to:

- Obtain data of sufficient quality and quantity to describe the physical and chemical properties of site soil and groundwater;
- Determine the nature and extent of contamination;
- Characterize the fate and transport of identified contaminants; and
- Evaluate the need and potential options for remedial actions.

This investigation will focus on further evaluating soil quality conditions associated with areas where dynamite was produced, transported, and handled. Previous field investigations and cleanup actions performed by Dyno primarily addressed ANFO and MEAN production and handling facilities, the Culvert Plant, and several burn pits/landfills (including the Drum Burial Area). In general, soil quality conditions associated with dynamite facilities that operated prior to 1969 are not as well characterized. As part of the Phase II investigation, groundwater quality within dynamite production areas (e.g., Old and New Nitrators, Neutralizer House, Mix House) was evaluated along with surface soil quality in the vicinity of dynamite and gelatin houses as well as magazines. To adequately characterize potential releases from dynamite production-related

facilities, additional soil quality investigations will be conducted. An additional round of site-wide groundwater sampling and analysis will also be conducted to supplement the existing groundwater data.

1.5 Scope of Work Elements

To develop a scope of work for a RI/FS, previous experience obtained from similar sites is typically used as a tool for identifying areas and contaminants of potential concern as well as focusing the field investigation. Within Washington State, the cleanup site most similar to Pacific Powder is the Former DuPont Works Site. The DuPont Works was an explosives manufacturing plant that operated from 1906 until the mid-1970s. There are a number of similarities and key differences between the DuPont and Pacific Powder operations. Numerous field investigations and cleanup actions have been performed at the Former DuPont Works Site as part of a consent decree with Ecology. The findings of these investigations, along with site-specific operational records for the Pacific Powder site, were used to help develop scope of work elements described below.

This RI/FS sampling program will consist of seven primary tasks:

- **Perform Explosive Hazard Assessment (EHA).** An EHA was performed by a qualified explosives expert (Ed Meeks of MWH Americas, Inc.) to assist in the development of the RI/FS Work Plan and in support of the Site-Specific Health and Safety Plan (SSHSP). The EHA report, which is presented in Appendix C, includes the following information:
 - Detailed review of historical information relating to site-specific explosive constituent manufacturing performed at the facility;
 - Construction details of similar explosive manufacturing facilities;
 - Results of a physical inspection of the facility and surrounding areas;
 - Identification of areas potentially impacted by explosive constituents; and
 - Recommendations to safely conduct the proposed RI field investigation.
- **Prepare RI/FS Work Plan.** Prepare this plan for soil and groundwater characterization for Ecology review and approval. The Work Plan consists of a Project Overview, a Sampling and Analysis Plan (SAP), a Quality Assurance Project Plan (QAPP), and a SSHSP.
- **Perform Pre-sampling Vegetation and Explosives Clearing Activities.** Many of the old roads and trails that provided access to former facilities at the site are

overgrown with Scotch Broom and other vegetation. It will be necessary to clear this vegetation to provide access to a number of the proposed sampling sites.

In areas where nitroglycerin was produced and handled within the Old and New Nitrator Areas (e.g., Nitrator Houses, Neutralizer House, Mix House, Nitrocotton House, Acid Pond, and Spent Acid Batch House), a preventative explosive clearing program will also be performed to minimize potential safety hazards during implementation of the RI/FS sampling program. The preventative explosive clearing program will be performed by qualified explosives experts in a manner that will minimize uncontrolled releases of potentially impacted soils and decrease the potential of field sampling personnel encountering unsafe working conditions. Hercules has suggested such a program and they have agreed to identify qualified experts to perform the explosive clearing activities. A scope of work for the pre-sampling explosive clearing program has been developed as part of the EHA (see Appendix C). In general the explosive clearing program will include:

- Pre-excavation soil screening using an aerosol-based explosive field-test kit (EXPRAY™);
- Excavation to expose identified former process structure foundations and/or areas believed to have been used for the manufacturing and/or handling of explosive material including the Old Nitrator, Neutralizer, NG gutter berm linking the Old Nitrator and Neutralizer, and Mix House locations;
- Identification of potential process drainpipes or surface drainage features involved with the manufacturing and/or handling of explosive constituents;
- Removal of identified former process structure foundations and process oriented drainpipes;
- Initiation of a sympathetic detonation program within specific areas (including New and Old Nitrators, Neutralizer House; Nitroglycerin Storehouse; Mix House, and Acid Pond); and
- Document pre-sampling explosive clearing activities.

Any debris and impacted soil or material encountered during foundation excavation activities will be segregated and securely stockpiled. Disposition of contaminated material is not part of this RI/FS.

- **Conduct Soil Sampling Field Work.** An extensive soil sampling program will be conducted to supplement the Phase II investigation and to further evaluate soil quality within the following areas:

- Narrow Gauge Railroad;
- Standard Gauge Railroad Spurs;
- Old Nitrator Area facilities (including the Motor Room, Nitrator House, Spent Acid Batch House, Acid Pond, NG gutter system, and Neutralizer House);
- New Nitrator Area facilities;
- Mix, Nitro Cotton, and DNT Melting Houses;
- Magazines;
- Suspected laboratory buildings;
- Farm House Burn Pit;
- Seismic Pond Area (temporary well point);
- Trailer storage and miscellaneous disturbed areas; and
- Area-Wide surface soil sampling.

The scope of work for the soil sampling program is discussed in greater detail in Section 2.1. Proposed and existing surface soil sampling locations are shown on Figure 2-1.

- **Conduct Groundwater Sampling and Elevation Monitoring Field Work.** To better understand groundwater quality conditions and flow directions at the site, an additional round of groundwater sampling and water level monitoring will be performed on the wells installed during the Phase II investigation (shown on Figure 1-7) as well as the four Drum Burial Area wells (HC-MW-1 through HC-MW-4). Four additional monitoring wells will also be installed and sampled, including two within the Drum Burial Area, one downgradient of the DNT Melting House, and one downgradient of the New Nitrator Area nitroglycerin storage area (Figure 2-2).

In addition to performing groundwater sampling and testing, the old existing plant wells (identified as PP#1 through PP#9) will be properly decommissioned. Prior to decommissioning grounding well PP#5, a depth-specific water quality screening program will be performed to verify that elevated conductivities and low pH conditions historically observed in the well are not representative of surrounding water quality conditions.

The scope of work for the groundwater monitoring program is discussed in greater detail in Section 2.2.

- **Prepare RI Report.** The results of the field investigation and previous site investigations will be summarized in the RI Report. The RI laboratory data will be validated and tabulated, and graphics will be developed showing areas of impacted soil and/or groundwater (if any). Soil and groundwater

quality data will be compared to screening levels including current MTCA Method A and B cleanup levels for unrestricted land use and MTCA ecological indicator soil concentrations for the protection of terrestrial wildlife. Results of this evaluation will be summarized in the draft RI document. A draft RI will be submitted to Ecology for review. Based on comments received, the draft RI will be revised.

- **Prepare Focused FS Report.** We will also perform a Focused FS to qualitatively evaluate remedial alternatives, including the effectiveness of the interim remedial action conducted in the Drum Burial Area. We will evaluate the cost and performance for each of the alternatives in accordance with WAC 173-340-350. Results of this evaluation will be summarized in a draft FS Report. A draft FS will be submitted to Ecology for review. Based on comments received, the draft FS will be revised, incorporated with the RI into a single document, and submitted to Ecology for public review and comment.

1.6 Schedule

The schedule for the RI/FS investigation and reporting activities will be outlined in the Agreed Order.

2.0 SAMPLING AND ANALYSIS PLAN

This section provides an overview of the rationale and methods to be used for performing soil and groundwater sampling for the Pacific Powder site RI. Descriptions of the soil and groundwater sampling programs are presented in Sections 2.1 and 2.2, respectively. Sampling methods and handling procedures are discussed in Sections 2.3 and 2.4, respectively. Section 2.5 describes equipment decontamination procedures.

This Sampling and Analysis Plan was developed based on a general understanding of the dynamite manufacturing process and knowledge obtained during previous investigations, interviews with knowledgeable site personnel, and a review of documents provided by Dyno, Hercules, and others. To aid in evaluation of this plan, we present an overview of the general procedure to manufacture dynamite:

- The primary ingredients in the manufacture of dynamite include nitric acid, sulfuric acid, glycerin or ethylene glycol, neutralizing substance (i.e. soda ash), absorbent material (wood flour/diatomaceous earth/nitrocellulose), and detonation rate/temperature controllers (e.g., dinitrotoluene). The manufacture of dynamite is primarily comprised of the following five operations:
 - Manufacturing Nitroglycerin
 - Recovering Spent Acids
 - Neutralizing/Storing Nitroglycerin
 - Mixing Dynamite
 - Packing Dynamite
- The initial step in manufacturing dynamite is to either produce or purchase nitroglycerin. Because of the volatility and explosive power of nitroglycerin, it is generally manufactured at the site of dynamite production. Nitrating either glycol or ethylene glycol with a mixture of sulfuric and nitric acids creates nitroglycerin. The general ratio of acid mixture is 60 percent sulfuric acid and 40 percent nitric acid. Originally, the nitration process was first conducted in large vessels called batch nitrators. In an attempt to improve safety, however, batch nitrators were phased out and continuous nitrators were developed. Continuous nitrators remove the nitroglycerin from the nitration process resulting in only small quantities of nitroglycerin being present within the nitrating vessel at any given time.

- The acid used for nitration ("spent acid") is removed from the nitrator and attempts are made to recover the acid for future use. Since acid, in particular nitric acid, has a commercial value associated with it, significant attempts were commonly undertaken to recover the acid. The acid recovery units are generally located in close proximity to the nitrators and in many cases have associated ponds. The associated ponds historically were used to neutralize unrecoverable acid prior to discharge to the environment.
- An important step in the dynamite manufacturing process is the neutralization and storage of nitroglycerin. Nitroglycerin is delivered to the neutralizer/storehouse via a specially designed gravity feed gutter system. Nitroglycerin is very volatile and only in special circumstances can it be pumped. After nitration, nitroglycerin is low in pH and called "acidic nitroglycerin". Acidic nitroglycerin is not usable for manufacturing dynamite because an exothermic reaction will occur during the mixing phase that can result in a significant detonation. Generally, a neutralizing agent is applied to the nitroglycerin and the pH is stabilized in the neutral range. One of the most common neutralizing agents is soda ash. Many facilities combine the neutralization and storage operations into a single structure.
- Following the manufacture and neutralization of nitroglycerin, the next step is the mixing of dynamite. This is performed in specially prepared mixing vessels. The mixing vessels historically were commonly constructed of bronze. Nitroglycerin is delivered to the mix house via a specially designed buggy (i.e., "angel buggy") that typically carries approximately 500 pounds of nitroglycerin. The nitroglycerin is carefully added to the mixing vessel with the absorbent material and the appropriate detonation rate/temperature controllers. Typical absorbent material is wood flour, diatomaceous earth, or nitrocellulose. However, any material that will absorb and bind the nitroglycerin could be used. A typical detonation rate/temperature controller was dinitrotoluene. Since dinitrotoluene is a solid at room temperature, it is heated prior to use. Typically, the dinitrotoluene is stored and heated in close proximity to the mix house to ensure it remains a liquid for the mixing process. The materials are thoroughly mixed resulting in raw dynamite.
- The final step in manufacturing dynamite is packing the material in suitable containers called shells. Typically, carts or narrow gauge rail systems are used to transport the mixed dynamite to the packing houses. The packing operations are most routinely performed using specially designed dynamite packing machines. The dynamite is fed into a hopper that dispenses the appropriate quantity of dynamite into each shell. Once the dynamite is

placed in the shells, wooden dowels are used to tamp the dynamite ensuring the shell is completely filled with no voids. After the dynamite is packed, it is placed into shipment containers and stored in a specially designed magazine until being delivered to consumers.

2.1 Soil Quality Investigation

Soil sampling field investigations are described below by area or facility. Proposed and existing surface soil sampling locations are shown on Figure 2-1. Table 2-1 lists the planned soil quality samples and analyses for this investigation, corresponding to the discussions below.

2.1.1 Narrow Gauge Railroad

Objectives. To minimize fire hazards associated with conveyance of explosive materials along site railroads, it is possible that herbicides were used to control vegetation within the former narrow gauge railroad (NGRR) corridors. Surface soil sampling will be conducted along the location of the NGRR to evaluate whether potential applications of herbicides have impacted soil quality. As part of the Phase II investigation, surface soil sampling was conducted along the southern portion of the NGRR at the locations of the Dynamite and Gelatin Houses (Figure 2-1). Arsenic and lead concentrations observed in soil samples collected from these areas were below MTCA unrestricted cleanup levels and ecological indicator concentrations for wildlife with the exception of one sample, which slightly exceeded the background arsenic concentration of 20 mg/kg (sample DH2-SS2, 25.1 mg/kg). Additional soil samples will be collected along other segments of the NGRR to confirm that soil quality has not been significantly impacted.

Scope of Work. Prior to sampling, the location of the NGRR corridor will be surveyed and marked with stakes and/or flagging. Thick accumulations of Scotch Broom will also likely need to be removed prior to sampling. Discrete surface (upper 6 inches) soil samples will be collected at approximately 100-foot intervals along the NGRR corridor (Figure 2-1). At each sampling location, one sample will be collected within the former NGRR bed and a second sample will be collected approximately 15 feet perpendicular to the RR line in an alternating pattern (left or right of the bed). In areas where NGRR sample intervals overlap (within 50 feet) with other existing or proposed surface soil sampling locations (e.g., Dynamite and Gelatin House buildings) being tested for metals, NGRR samples will not be collected. In areas within the Powder Plant where buildings have been constructed over the NGRR bed location, samples will be collected

outside of the buildings at locations closest to the 100-foot sampling interval location as illustrated on Figure 2-1.

A total of 63 discrete soil samples from the NGRR corridors will be submitted for total arsenic and lead analysis. To evaluate the potential for chlorinated organic herbicide use, three samples containing higher natural organic matter contents (based on visual observation) will be analyzed for chlorinated herbicides (EPA Method 8151). Surface soil samples will be collected using stainless steel sampling equipment and will be homogenized in a stainless steel bowl before placement in laboratory-supplied containers. Soil sample locations will be documented using the Global Positioning System (GPS).

Surface soil samples will also be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

2.1.2 Standard Gauge Railroad Spurs

Objectives. Surface soil sampling will be conducted along the location of the standard gauge railroad (SGRR) spurs formerly located in the Powder and MEAN plant areas. The primary objective of this task is to evaluate whether potential applications of herbicides have impacted soil quality adjacent to the SGRR.

Scope of Work. Prior to sampling, the location of the SGRR corridors within the Powder and MEAN plants will be surveyed and marked with stakes and/or flagging. Discrete surface (upper 6 inches) soil samples will be collected at approximately 300-foot intervals along the MEAN Plant SGRR corridor (Figure 2-1). The larger sampling interval relative to the NGRR is warranted given the much shorter duration of the MEAN Plant SGRR existence during site explosives manufacture. Given that this rail spur was approximately 1,400 feet long, five sampling locations will be established. The SGRR in the Powder Plant area was about 1,200 feet long. In areas within the Powder Plant where buildings have been constructed over the SGRR bed location, samples will be collected outside of the buildings at locations closest to the 300-foot sampling interval location as illustrated on Figure 2-1.

Three surface soil samples will be collected at each of the 10 sampling locations using a linear grid system set perpendicular to the SGRR. The three samples will be collected approximately 15 feet apart with the middle sample being located

along the surveyed SGRR location. Surface soil samples will be collected using stainless steel sampling equipment and will be homogenized in a stainless steel bowl before placement in laboratory-supplied containers. A total of 30 discrete soil samples will be submitted for total arsenic and lead analysis. To evaluate the potential for chlorinated organic herbicide use, three samples containing higher natural organic matter contents (based on visual observation) will be analyzed for chlorinated herbicides (EPA Method 8151). Soil sample locations will be documented using GPS.

Surface soil samples will also be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

2.1.3 Old Nitrator Area

Objectives. Surface and subsurface soil sampling will be conducted within the Old Nitrator Area to evaluate potential impacts associated with demolition of lead-containing buildings, historical releases of nitroglycerin product and associated acidic wastes, and possible application of herbicides.

Scope of Work. Surface soil sampling will be the first task performed in the Old Nitrator Area. In areas where nitroglycerin was produced and handled within the Old Nitrator Area (e.g., Nitrator House, NG Gutter Alignment, Neutralizer House, Spent Acid Batch House, and Acid Pond), a preventative explosive clearing program will be performed prior to performing subsurface soil sampling to minimize potential safety hazards (see EHA included in Appendix C) and to locate potentially buried former building foundations or other structures. Analytical results of the surface soil sampling will be obtained prior to performing the excavation and sympathetic detonation program for locations where NG was produced and handled. If surficial soil contamination is identified, protective measures (e.g., impacted soil removal) will be implemented to minimize potential spread of contamination during excavation and detonation activities.

- **Surface Soil Sampling.** To evaluate potential impacts associated with demolition of lead-containing structures and possible herbicide applications, discrete surface (upper 6 inches) soil samples will be collected within a 50-foot staggered grid pattern established across the area encompassing the Motor Room, Nitrator House, and Spent Acid Batch House. Ten soil

samples will be collected within this gridded area. Four additional surface soil samples will be collected at the location of the former Neutralizer House, three surface samples will be collected along the NG Gutter System, and four samples within the acid pond (Figure 2-1). Surface soil samples will be collected using stainless steel sampling equipment and will be homogenized in a stainless steel bowl before placement in laboratory-supplied containers. A total of 21 discrete surface soil samples will be submitted for total arsenic and lead analysis. To evaluate the potential for chlorinated organic herbicide use, three samples located next to former or existing structures will be analyzed for chlorinated herbicides (EPA Method 8151). Soil sample locations will be documented using GPS.

Surface soil samples will also be screened for the presence of explosives using EXPRAY[™]. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

- **Nitrator/Neutralizer Mound Excavation.** Earthen barricades were formerly located adjacent to the Nitrator and Neutralizer Houses. Currently the only visible remnants of these building locations are mounds connected by a berm-like structure that formerly contained the Nitroglycerin Gutter System (Figure 2-1). It is possible that the foundations for the Old Nitrator and Neutralizer buildings may have been located well below the current top of the existing mounds and were buried during decommissioning. Ken Dunkin (APPCO) was told that the foundations were buried.

A trackhoe or backhoe equipped with a blast shield will be used to excavate into the existing mounds and berm-like structure in an attempt to locate potentially buried foundations or other structures, or debris from their demolition. A qualified explosives expert will direct the excavation work. During excavation activities, field personnel will be stationed a safe distance away from the area being excavated. In zones where anthropogenic features are encountered, or where directed by the on-site explosives expert, soils will be screened for the presence of explosives using EXPRAY[™] at approximately 3-foot-depth intervals. This will be accomplished by testing the soil in the backhoe/trackhoe bucket so that field personnel do not need to enter the excavation. If a strong color associated with the presence of nitroglycerin is observed during colorimetric screening, excavation will be discontinued, access to the area will be restricted, and a plan will be

developed to address the collection, disposal, and/or destruction of the nitroglycerin (see EHA presented in Appendix C).

Soils excavated from the mounds and berm-like structures will be segregated based on visual and EXPRAY™ screening results and stockpiled in plastic-lined bermed areas for storage and subsequent characterization sampling. Samples will be tested for total arsenic, lead, and nitroglycerin at a frequency of approximately one discrete sample per 500 cubic yards. If loose demolition debris is encountered, it will be placed in a separate stockpile location for potential waste designation sampling and analysis and off-site disposal. Excavation within the nitrator/neutralizer mounds will be advanced until foundations are encountered or until at or slightly below the surrounding ground surface. Because it is possible that decommissioned gutters were buried beneath berm soil, excavation of the berm-like structure will also continue until at or slightly below the surrounding ground surface.

If foundations are encountered, the perimeter of the foundation will be excavated to a depth 3 to 5 feet below its base to determine whether process drains exist. Interviews with a former Hercules employee (Derick Pyle) indicated that nitroglycerin-containing liquid waste was discharged to a rock-filled sump located along the west side of the Neutralizer House. The sump was periodically detonated to remove residual nitroglycerin product. The Neutralizer House perimeter trench will be extended and widened as needed to encompass the area of the suspected sump indicated by Mr. Pyle.

In the event that process drains, sumps, or drainpipes that may potentially contain nitroglycerin are encountered, excavation and sampling in the area will be discontinued until a plan can be developed to address removal of the potential explosive material. If none of these structures are encountered, a sympathetic detonation program will be performed to address potential residual explosive hazards as outlined in the EHA (Appendix C).

Additional excavation will be performed along the portion of the gutter berm-like structure that borders the acid pond to locate potentially buried piping. Excavation activities will be conducted in a similar manner as described for the nitrator/neutralizer mounds. If piping is encountered that may contain nitroglycerin, excavation and sampling in the area will be discontinued until a plan can be developed to address removal of the explosive material. If piping that may contain nitroglycerin is not encountered, a sympathetic detonation program will be performed in the Acid Pond area to address potential residual explosive hazards as outlined in the EHA (Appendix C).

Any debris and impacted soil or material encountered during excavation of the Nitrator or Neutralizer mounds will be segregated and securely stockpiled. Disposition of contaminated material is not part of this RI/FS.

- **Nitrator and Spent Acid Batch Houses Subsurface Soil Sampling.** Following implementation of the pre-sampling excavation and sympathetic detonation programs described previously, trenches installed along the periphery of the former building foundations will be examined for potential subsurface conduits or visual evidence of nitroglycerin and acid releases (e.g., acid etching). If suspect conduits or releases are encountered, the trench will be extended to delineate the extent of the feature and soil samples will be collected at these locations. If no conduit or evidence of contamination is encountered, two trenches will be excavated perpendicular to each other, through the center of the former structure and extending 20 feet beyond each side. In this case, four to five soil samples will be collected in a cross-shaped grid pattern from the trenches at depths of 2 to 3 feet below ground surface. If the foundation is no longer present, one soil sample will be collected at the intercept of the trenches (corresponding to the center of former building location) with the remaining four samples collected approximately 10 feet outside of the four edges of the former structure. Depending on whether building foundations are present, four to five subsurface soil samples collected from each building location (total of 8 to 10 samples) will be submitted for analysis of nitroglycerin and total lead.
- **Acid Pond Subsurface Soil Sampling.** Four test pits will be installed across the location of the former acid pond. The test pits will be installed to a depth of 3 feet to evaluate potential subsurface presence of nitroglycerin and metals associated with acid releases. Each test pit will be examined for evidence of contamination, and will be deepened to delineate vertical extent of visually impacted soils if encountered. One subsurface soil sample will also be collected from each test pit location at a depth of 2 to 3 feet below ground surface or within zones of suspected contamination. The four subsurface soil samples will be submitted for analysis of nitroglycerin and total lead.
- **NG Gutter System Subsurface Soil Sampling.** Three 20-foot-long trenches will be installed perpendicular to the gutter system that extended between the Nitrator and Neutralizer House to evaluate potential subsurface releases of nitroglycerin. The trenches will be spaced at approximately 100-foot intervals and will be excavated to depths of 3 feet below ground surface. The trench installed adjacent to the acid pond may be completed during the Nitrator/Neutralizer mound excavation program discussed previously. Each

trench will be examined for evidence of contamination. One soil sample will be collected from the central portion of each trench at a depth of 2 to 3 feet below ground surface or within zones of suspected contamination. The three subsurface soil samples will be analyzed for nitroglycerin and total lead.

- **Neutralizer House Subsurface Soil Sampling.** Trenches installed along the periphery of the former building foundation (if located) will be examined for potential subsurface conduits or visual evidence of nitroglycerin and acid releases (e.g., acid etching). If suspect conduits or releases are encountered, the trench will be extended to delineate the extent of the feature and soil samples will be collected at these locations. If no conduit or evidence of contamination is encountered, two trenches will be excavated perpendicular to each other, through the center of the former structure and extending 20 feet beyond its sides. In this case, one soil sample will be collected at the center of the former building location (if foundation is no longer present) with the remaining four samples collected approximately 10 feet outside of the four edges of the former structure. Regardless of whether visual evidence of the suspected sump is present, one soil sample will be collected from the west side of the Neutralizer House to confirm contaminant presence/absence. Five to six subsurface soil samples collected from the trenches will be analyzed for nitroglycerin and total lead.
- **Buggy Trail.** Rubber-tired buggies were used to transport nitroglycerin from the Neutralizer House to the Mix House along a trail shown on Figure 2-1. To evaluate soil quality along the Buggy Trail, three 20-foot-long trenches will be installed perpendicular to the trail. The trenches will be excavated to depths of 3 feet below ground surface and examined for evidence of contamination. One soil sample will be collected from the central portion of each trench at a depth of 2 to 3 feet below ground surface or within zones of suspected contamination. The three soil samples will be analyzed for nitroglycerin. Three surface soil samples will also be collected along the trail and will be analyzed for total arsenic and lead.

2.1.4 New Nitrator Area

Objectives. Because the New Nitrator Area was only in operation for less than 1 year and reportedly used technologies that limited the potential for acid and nitroglycerin releases, subsurface contamination in this area is expected to be minimal. Soil sampling within the New Nitrator Area will focus on evaluating potential impacts associated with demolition of lead-containing buildings and possible short-term application of herbicides.

Scope of Work. Consistent with the Old Nitrator Area, surface soil sampling will be the first task performed in the New Nitrator Area. In areas where nitroglycerin was produced and handled within the New Nitrator Area (e.g., Nitrator House, Nitroglycerin Storehouse), a preventative explosive clearing program will be performed following surface soil sampling to minimize potential safety hazards (see EHA included in Appendix C) and locate potentially buried former building foundations or other structures. Analytical results of the surface soil sampling will be obtained prior to performing the preventative explosive clearing program. If surficial soil contamination is identified, protective measures (e.g., impacted soil removal) will be implemented to minimize potential spread of contamination during excavation and detonation activities.

- **Surface Soil Sampling.** Discrete surface (upper 6 inches) soil samples will be collected within a 100-foot grid pattern established across the western portion of the New Nitrator area. Ten soil samples will be collected within this gridded area. A separate grid with an additional ten soil samples will be established in the vicinity of the Nitroglycerin Storehouse located along the northeastern corner of the New Nitrator Area (Figure 2-1). Surface soil samples will be collected using stainless steel sampling equipment and will be homogenized in a stainless steel bowl before placement in laboratory-supplied containers. The 20 discrete soil samples will be submitted for analysis of total arsenic and lead. Soil sample locations will be documented using GPS.

Surface soil samples will also be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

- **Preventative Explosive Clearing Program.** A trackhoe or backhoe equipped with a blast shield will be used to excavate within the former Nitrator and Nitroglycerin Storehouse building locations to locate potentially buried foundations or other structures, or debris from their demolition. A qualified explosives expert will direct the excavation work. During excavation activities, field personnel will be stationed a safe distance away from the area being excavated. In zones where anthropogenic features are encountered, or where directed by the on-site explosives expert, soils will be screened for the presence of explosives using EXPRAY™ at approximately 3-foot-depth intervals. This will be accomplished by testing the soil in the backhoe/trackhoe bucket so that field personnel do not need to enter the excavation.

If a strong color associated with the presence of nitroglycerin is observed during colorimetric screening, excavation will be discontinued, access to the area will be restricted, and a plan will be developed to address the collection, disposal, and/or destruction of the nitroglycerin (see EHA presented in Appendix C).

Soils excavated from the building locations will be segregated based on visual and EXPRAY™ screening results and stockpiled in plastic-lined bermed areas for storage and subsequent characterization sampling and analysis. If nitroglycerin is detected during screening or other visual evidence of contamination is observed (e.g., lead debris), samples will be tested for total arsenic, lead, and nitroglycerin at a frequency of approximately one discrete sample per 500 cubic yards. If loose demolition debris is encountered, it will be placed in a separate stockpile location for potential waste designation sampling and off-site disposal. Excavation within the former Nitrator and Nitroglycerin Storehouse locations will be advanced 10 feet below current grade or until foundations are encountered.

Any debris and impacted soil or material encountered during excavation in the New Nitrator area will be segregated and securely stockpiled. Disposition of contaminated material is not part of this RI/FS.

If foundations are encountered, the perimeter of the foundation will be excavated to a depth below its base to determine whether process drains exist. In the event that process drains, sumps, or drainpipes that may potentially contain nitroglycerin are encountered, excavation and sampling in the area will be discontinued until a plan can be developed to address removal of the potential explosive material. If none of these structures are encountered, a sympathetic detonation program will be performed to address potential residual explosive hazards as outlined in the EHA (Appendix C). Subsurface soil samples will not be collected unless there are indications of subsurface contamination during the EHA or excavation programs.

2.1.5 Mix, Nitro Cotton, and DNT Melting Houses

Objectives. Activities in this area primarily involved the transport and mixing of DNT and/or nitro cotton (a.k.a., nitrocellulose) with nitroglycerin to form various explosive products. Surface and subsurface soil sampling will be conducted within this area to evaluate potential impacts associated with demolition of lead-containing buildings, historical releases of nitroglycerin and DNT product, and possible application of herbicides.

Scope of Work. Prior to sampling, additional efforts will be made to determine the location of the former DNT Melting House. Interviews with Derick Pyle provided two possible locations for this facility, which was described as a small asbestos-lined metal shed located beneath a stand of trees. According to Mr. Pyle, the DNT Melting House was located either south or northwest of the Mix House. Based on discussions with Ed Meeks (Hercules consultant who has worked on a number of former Hercules dynamite manufacturing facilities) and review of historical aerial photographs, we believe the most likely scenario is that the Melting House was part of the Buggy House located along the Buggy Path (Figure 2-1). As part of our effort to locate the DNT Melting House, we will seek Ecology's assistance in obtaining additional information from Bill Garson.

Once the location of the former DNT Melting House has been located, the following soil sampling tasks will be performed.

- **Surface Soil Sampling.** To evaluate potential impacts associated with demolition of lead-containing buildings and possible herbicide applications, discrete surface (upper 6 inches) soil samples will be collected at the locations of the former Mix, Nitro Cotton, and DNT Melting Houses. At each of the three building locations, a five-point grid-like pattern will be established to allow coverage of the building footprint as well as the surrounding area including the NGRR at the Mix House and DNT Melt House if in the location south of the Mix House (Figure 2-1). Surface soil samples will be collected using stainless steel sampling equipment and will be homogenized in a stainless steel bowl before placement in laboratory-supplied containers. A total of 15 discrete surface soil samples will be submitted for total arsenic and lead analysis. To evaluate the potential for chlorinated organic herbicide use, three samples containing higher natural organic matter contents (visually) will be analyzed for chlorinated herbicides (EPA Method 8151). Soil sample locations will be documented using GPS.

Surface soil samples will also be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

- **Mix House Mound Excavation.** An earthen barricade was formerly located adjacent to the Mix House. Currently the only visible remnant of the Mix House area is a large mound. It is possible that the foundation for the Mix

House may have been located well below the current top of the existing mound and was buried during decommissioning.

A trackhoe or backhoe equipped with a blast shield will be used to excavate into the existing mound in an attempt to locate the potentially buried foundation or other structures, or debris from their demolition. A qualified explosives expert will direct the excavation work. During excavation activities, field personnel will be stationed a safe distance away from the area being excavated. In zones where anthropogenic features are encountered, or where directed by the on-site explosives expert, soils will be screened for the presence of explosives using EXPRAY[™] at approximately 3-foot-depth intervals. This will be accomplished by testing the soil in the backhoe/trackhoe bucket so that field personnel do not need to enter the excavation. If a strong color associated with the presence of nitroglycerin or other explosives are observed during colorimetric screening, excavation will be discontinued, access to the area will be restricted, and a plan will be developed to address the collection, disposal, and/or destruction of the explosive material (see EHA presented in Appendix C).

Soils excavated from the mound will be segregated based on visual and EXPRAY[™] screening results and stockpiled in plastic-lined bermed areas for storage and subsequent characterization sampling and analysis. Samples will be tested for total arsenic, lead, nitroglycerin, and nitroaromatics-nitroamines by EPA Method 8330 at a frequency of approximately one discrete sample per 500 cubic yards. If loose demolition debris is encountered, it will be placed in a separate stockpile location for potential waste designation sampling and analysis and off-site disposal. Excavation within the Mix House mound will be advanced until the foundation is encountered or until the grade at the former building location is at or slightly below the surrounding ground surface.

Any debris and impacted soil or material encountered during excavation in the New Nitrator area will be segregated and securely stockpiled. Disposition of contaminated material is not part of this RI/FS.

If the Mix House foundation is encountered, the perimeter of the foundation will be excavated to a depth 3 to 5 feet below its base to determine whether process drains exist. In the event that process drains, sumps, or drainpipes that may potentially contain nitroglycerin or other explosives are encountered; excavation and sampling in the area will be discontinued until a plan can be developed to address removal of the potential explosive material. If none of these structures are encountered, a sympathetic

detonation program will be performed to address potential residual explosive hazards in the Mix House area as outlined in the EHA (Appendix C).

- **Mix House Subsurface Soil Sampling.** To evaluate potential subsurface releases of nitroglycerin and DNT, trenches excavated along the periphery of the foundation will be examined for potential subsurface conduits or visual evidence of releases. If suspect conduits or releases are encountered, the trench will be extended to delineate the extent of the feature and soil samples will be collected at these locations. If no conduit or evidence of contamination is encountered, two trenches will be excavated perpendicular to each other, through the center of the former structure and extending 20 feet beyond the sides of it. In this case, soil samples will be collected in a cross-shaped grid pattern from the trenches at depths of 2 to 3 feet below ground surface. Four samples will be collected approximately 10 feet outside of the four edges of the former structure. If the foundation is not present, a fifth soil sample will be collected at the center of the former structure location. The subsurface soil samples will be submitted for analysis of nitroglycerin and nitroaromatics-nitroamines (including DNT) by EPA Method 8330 and total lead.
- **DNT Melting House.** To evaluate potential subsurface releases of DNT, trenches will be excavated to a depth of 3 feet to search for potential subsurface conduits or visual evidence of releases. A trench will be excavated around the perimeter of the structure, whether present or not. If suspect conduits or releases are encountered, the trench will be extended to delineate the extent of the feature and soil samples will be collected at these locations. If no conduit or evidence of contamination is encountered, two trenches will be excavated perpendicular to each other extending 20 feet beyond the sides of the structure, and, if the structure is not present, through the center of the former structure. In this case, subsurface soil samples will be collected in a cross-shaped grid pattern from the trenches at depths of 2 to 3 feet below ground surface. Four samples will be collected approximately 10 feet outside of the four edges of the structure. If the foundation is not present, a fifth soil sample will be collected at the center of the former structure location. The subsurface soil samples will be submitted for analysis of nitroaromatics-nitroamines (including DNT) by EPA Method 8330 and total lead.

2.1.6 Magazines

Objectives. Surface soil sampling of the magazine locations was completed as part of the Phase II investigation. However, the location of Magazine 2 was initially misidentified as a barricaded area southwest of the MEAN Plant Area. The actual location for Magazine 2 is in the southeastern corner of the site (Figure 2-1). This location will be sampled to evaluate potential releases of metals from the burning of the structure and possible application of herbicides.

Additional soil samples will also be collected from Magazines 3 and 4 to verify that soil quality in the adjacent berms has not been impacted (there is no berm remaining at Magazine 1). Because Magazines 3 and 4 have been a part of the explosives manufacturing process as long as the explosives plant has existed, were burned as part of demolition, and have existing soil berms still in place, they provide useful information regarding potential for dispersal of lead associated with the burning.

Blasting caps (a.k.a. detonators) were not manufactured at the site. They were stored separately from the finished explosives in small block houses or a Quonset hut. Blasting caps are sealed at the factory to prevent tampering and explosives from leaking. Because of the very sensitive nature of primary explosives within blasting caps, the sealing process is very stringent. Therefore, the potential for environmental releases associated with blasting cap storage areas are very minimal. No further sampling in the vicinity of the blasting cap storage areas is proposed.

Dyno's magazine decommissioning documents indicate that the walls and flooring of the buildings were constructed of wood (Ken Dunkin of APPCO indicated that Magazine 2 had a concrete foundation). No visible evidence of the magazine buildings (e.g., wood or metal debris, paint chips, etc) remains except for a concrete pad at the Magazine 1 site. Because of their age, it is highly likely that the magazine structures contained lead-based paint. If the magazine structures did contain lead-based paint, their burning could have deposited lead particulate on the inner walls of the berms immediately surrounding the structure. If such burning occurred, we expect that the highest lead concentrations would be present on these berm soils.

Scope of Work. The following surface soil sampling tasks will be performed in the magazine areas:

- **Magazine 2.** To evaluate potential impacts associated with demolition and burning of the magazine building and possible herbicide applications, three

discrete surface (upper 6 inches) soil samples will be collected in the vicinity of the magazine building location. Three additional samples will be collected from the adjacent inner berm walls. The six samples will be analyzed for total arsenic and lead. To evaluate the potential for chlorinated organic herbicide use, one sample from the building location containing a higher natural organic matter content (based on visual observation) will be analyzed for chlorinated herbicides (EPA Method 8151).

- **Magazine 3.** Four additional discrete surface soil samples will be collected. Three soil samples will be collected from the adjacent inner berm walls and one soil sample will be collected from the base of a stormwater sump. The four soil samples will be analyzed for total arsenic and lead.
- **Magazine 4.** Three additional discrete surface soil samples will be collected from the adjacent inner berm walls and analyzed for total arsenic and lead.

Surface soil samples collected from Magazine Areas 2, 3, and 4 will also be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330). Soil sample locations from Magazine Areas 2, 3, and 4 will be documented using GPS.

2.1.7 Suspected Laboratory Buildings

Objectives. As part of the Phase II investigation, surface soil sampling was conducted at one of the Hercules laboratories located west of the Powder Plant Area (Figure 1-4). Metal concentrations were generally below MTCA unrestricted cleanup levels although mercury concentrations (to 1.6 mg/kg) were above Puget Sound background conditions. According to 1964 Hercules plant map, an additional “EGD” laboratory was located north of the entrance road near the former engineering office (Figure 1-4, Building 4). The function of this apparent laboratory is uncertain. Mr. Pyle also indicated that a portion of the Former Hercules Office located near the entrance gate was used as a laboratory (Figure 1-1). Although Mr. Pyle indicated that laboratory operations conducted by Hercules at the site were controlled and did not produce significant mercury releases, additional sampling will be performed at these former laboratory sites to verify that soil quality has not been significantly impacted.

Scope of Work. The following soil sampling tasks will be performed at the laboratory sites and soil sample locations will be documented using GIS:

- **Former Hercules Office (a.k.a., Caretaker Residence).** Four discrete surface soil samples will be collected around the existing building (one from each side). The samples will be analyzed for total arsenic, lead, and mercury.
- **“EGD” Laboratory.** Four discrete surface soil samples will be collected at the location of the former building (Figure 2-1). The samples will be analyzed for total arsenic, lead, and mercury.
- **Laboratory (West of Powder Plant).** Low concentrations of mercury were detected in surface soils at this former lab. To evaluate potential subsurface releases of mercury, trenches will be excavated to a depth of 3 feet to search for potential subsurface conduits or visual evidence of releases. A trench will be excavated around the perimeter of the former structure. If suspect conduits or mercury releases are encountered, the trench will be extended to delineate the extent of the feature and soil samples will be collected at these locations. If no conduit or evidence of contamination is encountered, two trenches will be excavated perpendicular to each other extending 10 feet beyond the sides of the former structure. Subsurface soil samples will be collected in a cross-shaped grid pattern from the trenches at depths of 2 to 3 feet below ground surface. One soil sample will be collected at the intercept of the trenches (corresponding to the center of the former laboratory location) with the remaining four samples collected at the ends of both trenches. The five subsurface soil samples will be submitted for analysis of total lead and mercury.

Soil samples collected from the three laboratory sites will also be screened for the presence of explosives using EXPRAY[™]. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

2.1.8 Farm House Burn Pit

Objectives. Soil samples will be collected in this area to verify that the burning of electronic detonators has not impacted soil quality. During cleanup operations conducted by Dyno, burned caps and copper wire were encountered in a small (10- by 10- by 4-foot) pit located next to the old farmhouse site (Figure 1-5). Dyno stated in its 1994 cleanup report and

associated field reports that, although it appeared that old electronic detonators were burned in the pit, excavation and testing activities did not encounter unburned caps or "hazardous contaminants." No soil quality testing data for this area were provided in the report so the number of samples collected and type of testing performed are not known.

Scope of Work. Two trenches will be installed perpendicular to each other across the location of the former burn pit. The trenches will be installed to a depth of 5 feet to search for potential electrical debris or visual evidence of contamination. If debris or evidence of contamination is encountered, soil samples will be collected at these locations. If no debris or evidence of contamination is encountered, five soil samples will be collected in a cross-shaped grid pattern from the trenches at depths of 4 to 5 feet below ground surface. One soil sample will be collected at the intercept of the trenches with the remaining four samples collected approximately 10 feet from the center sample. The five subsurface soil samples will be submitted for analysis of total metals (including As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn), nitroaromatics-nitroamines, PCBs, and polycyclic aromatic hydrocarbons (PAHs). Soil sample locations will be documented using GPS.

2.1.9 Seismic Pond Area

Objectives. Dyno's 1994 cleanup report mentioned the presence of a seismic pond that was used for testing the quality and reliability of explosives manufactured at the Pacific Powder plant. The exact location and size of the pond were not presented in the report but it was shown to be present in the general area northwest of the Farm House Burn Pit (Figure 1-5). Ken Dunkin of APPCO indicated that the Seismic Pond consisted of a small semi-circular depression located at the edge of the wetland area. Dyno's reports stated the Seismic Pond area was clean, and soil was being contoured.

As part of this RI/FS Work Plan development, Citifor's former consultant (Mark Johns of Exponent) was contracted to help locate the seismic pond and described his observations during Dyno's cleanup activities. Mr. Johns was able to locate the pond area in the field and provided photographs documenting Dyno's restoration activities (pulling soil back from the edge of a wetland and grading).

We do not have any records containing sampling data for the seismic pond. However, we do not anticipate encountering significant soil or water quality issues in this area. Ed Meeks (Hercules consultant) indicated that soil and water quality typically has not been significantly impacted within seismic ponds located

at other Hercules facilities. Ken Dunkin stated that sediment at the bottom of the pond was removed and disposed of off site prior to decommissioning the pond. Because the seismic pond area is now a nicely vegetated wetland-like area surrounded by forest, soil sampling via test pits would be highly destructive to this habitat. Furthermore, the gravelly substrate cannot be effectively sampled using standard drilling techniques. Sampling of shallow groundwater using non-destructive techniques is the best approach for evaluating environmental quality in the Seismic Pond area.

Scope of Work. A temporary shallow well will be installed within the Seismic Pond area. Due to the lack of road access and sensitive nature of the wetland-like habitat, we will initially attempt to install a 3-foot stainless steel wellpoint using hand techniques. Surficial grassy vegetation will be carefully dug out and removed so that it can be replanted following decommissioning of the temporary wellpoint. A posthole digger and/or pickaxe will be used to dig 1 to 2 feet into the gravelly soils. The wellpoint will be driven at least 2 feet below the water table using a slide hammer or portable mechanical hammer. The gravelly nature of soils in this area may prevent us from advancing the wellpoint by hand. If hand techniques are not successful, a portable power auger will be used to advance the well.

Following installation, the wellpoint will be developed by removing at least 10 casing volumes of water. After allowing groundwater within the wellpoint to recover for at least a 24-hour period, the wellpoint will be purged and sampled using low flow sampling techniques. The groundwater sample will be analyzed for nitroaromatics-nitroamines (EPA Method 8330), TPH (TPH-G and -D extended), perchlorate (EPA Method 314.0), nitroglycerin (EPA Method 8330), dissolved metals (including As, Cd, Cr, Cu, Hg, Pb, Ni, and Zn), total suspended solids (TSS), and miscellaneous inorganics (including nitrate, ammonia, sulfate, sodium, and chloride). Groundwater pH, temperature, dissolved oxygen, and specific conductivity will be measured in the field.

Following sampling, the temporary wellpoint will be left in place until the groundwater sampling results are obtained and Ecology concurs with decommissioning the wellpoint.

2.1.10 Trailer Storage and Miscellaneous Disturbed Areas

Objectives. Surface soil samples will be collected in several areas identified on aerial photographs as being disturbed by trailer storage or other unknown site activities to evaluate potential impacts to soil quality. These areas are shown on Figures 1-5 and 2-1. Ken Dunkin (APPCO) indicated that these areas were used

to store trailers with packaged explosive product (ANFO). He indicated there was no product handling or spillage in these areas; just trailer storage of material that needed to be reworked in the plant (off-specification material). No environmental investigations or cleanup activities are known to have occurred in these areas. If surface soil contamination is encountered in these areas, additional subsurface exploration will likely be initiated.

Scope of Work. The following surface soil sampling tasks will be performed in the trailer storage and other disturbed areas:

- **Trailer Storage Areas.** At each of the two trailer storage areas identified on Figure 2-1, five discrete surface (upper 6 inches) soil samples will be collected in a spatially distributed grid pattern and analyzed for diesel- and oil-range TPH (TPH-D extended) and total arsenic and lead (total of 10 samples). Soil sample locations will be documented using GPS.
- **Late 80s, Early 90s Era Berm.** Ken Duncan (APPCO) did not think this bermed location was used much, but it may have been used sparingly to store packaged explosive shipments pending transport. Six discrete surface (upper 6 inches) soil samples will be collected from this area. Three discrete soil samples will be collected from the flat area located inside the berm and three samples will be collected from the berm materials. The six samples will be analyzed for diesel- and oil-range TPH and total arsenic and lead. Soil sample locations will be documented using GPS.
- **Unidentified Disturbed Areas.** At each of the four unidentified disturbed areas identified on Figure 2-1, three discrete surface (upper 6 inches) soil samples will be collected and analyzed for diesel- and oil-range TPH and total arsenic and lead (total of 12 samples). Soil sample locations will be documented using GPS.

Soil samples collected from the trailer storage and disturbed area sites will also be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

2.1.11 Area-Wide Surface Soil Sampling

Objectives. To evaluate potential aerial dispersion of arsenic and lead associated with the burning of site structures during plant decommissioning,

surface soil samples will be collected downwind of the explosives production and magazine areas. According to the National Climatic Data Center, for the period from 1930 until 1996, the predominant wind direction for Olympia during each month was from the south-southwest. Therefore, areas north-northeast of the locations where buildings were burned would be expected to have greatest probability of impact, if such aerial transport of arsenic and lead occurred. Sampling will also be conducted south of the production and magazine areas to address potential aerial deposition during atypical wind conditions.

Scope of Work. A staggered 500-foot grid will be established across the northern and central portion of the property (Figure 2-1). One surface soil (upper 6 inches) sample will be collected within each grid section at a location that is at least 20 feet from roads, railroad grades, structures, or wetlands. For safety reasons, gridded sample locations falling on steep slopes (north of railroad tracks) will be moved due north, south, east, or west to reach flatter ground. Area-wide surface soil grid samples located within 100 feet of other existing or proposed surface samples being tested for total arsenic and lead will not be collected. We anticipate that approximately 125 surface soil samples will be collected on this grid, including 22 north of the existing SGRR tracks. Soil samples will be analyzed for total arsenic and lead. Soil sample locations will be documented using GPS.

Surface soil samples collected south of the existing SGRR tracks will also be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the detected explosive compounds (e.g., EPA Method 8330).

2.2 Groundwater Quality Investigation

To verify groundwater quality conditions and flow directions at the site, an additional round of groundwater sampling and water level monitoring will be performed on the wells installed during the Phase II investigation as well as the four Drum Burial Area wells (HC-MW-1 through HC-MW-4) shown on Figure 2-2. Four additional monitoring wells will be installed including one downgradient of the DNT Melting House (DM-MW-1), one downgradient of the New Nitrator Area nitroglycerin storage area (NN-MW-5), and two wells in the Drum Burial Area (HC-MW-5 and HC-MW-6).

In addition to performing groundwater sampling and testing, the old existing plant wells (identified as PP 1 through PP 9) will be properly abandoned. Prior to abandoning grounding well PP 5, a depth-specific water quality screening program will be performed to verify that elevated conductivities and low pH conditions historically observed in the well are not representative of surrounding water quality conditions (see Section 2.2.4).

The scope of the groundwater quality investigation is described in greater detail below.

2.2.1 Monitoring Well Installation

Prior to installing new wells, the location of the former DNT Melting House will be verified. One monitoring well (DMH-MW1) will be installed downgradient (west) of the DNT Melting House, New Nitrator Area nitroglycerin storage area (NN-MW5), and the Drum Burial Area (HC-MW-5) (Figure 2-2). One additional well (HC-MW-6) will be installed along the northwestern corner of Drum Burial Area Excavation 1. The wells will be installed using a hollow-stem auger drill rig and will consist of 2-inch-diameter PVC plastic well casings with 10-foot-long, 20-slot well screens placed across the water table.

The new monitoring wells will be developed to remove fine-grained sediment and improve hydraulic connection with the surrounding aquifer.

2.2.2 Groundwater Sampling

One round of groundwater samples will be collected from the 25 existing monitoring wells (assuming adequate groundwater recovery) and the four new wells. If groundwater cannot be sampled due to insufficient yield (e.g., Powder Plant wells PP-MW1 and PP-MW4), we will attempt to sample the wells during the wet season. Samples will generally be collected using a peristaltic pump following low-flow sampling techniques to minimize suspended solids in the samples. Depending on the past history of the area of concern, the groundwater samples will be analyzed for constituents of potential concern including TPH, volatile organics, inorganics (including nitrate, ammonia, sulfate, sodium, and chloride), glycols, nitroglycerin, NA/NA (including DNT), semivolatile organics, perchlorate, pH, and dissolved metals (including As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn). The analytes for groundwater samples from within each area of concern are summarized in Table 2-2.

2.2.3 Water Level Monitoring

The top of casing elevations for the four new wells will be surveyed using the same datum as other wells at the site. Groundwater elevation measurements will be obtained from the 29 wells and plotted to verify the groundwater flow direction.

2.2.4 Well PP#5 Water Quality Evaluation

A depth-specific water quality screening program will be performed to verify results of previous studies which indicated that plant grounding well PP#5 was not in good hydraulic connection with the surrounding aquifer and did not contain groundwater quality representative of surrounding water quality conditions. Groundwater pH, temperature, and specific conductivity will be measured at 2-foot-depth intervals through the entire water column present in well PP#5 and the adjacent downgradient well PP-MW2 (Figure 2-2) using a low-flow sampling pump. Water level drawdown will also be monitored during purging to help ascertain each well's relative degree of hydraulic connection with the aquifer.

Water quality screening results obtained from the two wells will be compared to each other and previous Powder Plant Area groundwater monitoring results. If water quality screening results obtained from well PP#5 exhibit elevated conductivities with significant stratification relative to the adjacent downgradient well PP-MW2, the data will confirm the finding of previous studies that indicated well PP#5 is a relatively stagnant grounding well that is not representative of surrounding water quality conditions. If water quality screening parameters are relatively similar between the two wells (e.g., conductivity relative percent differences less than 75 percent), well PP#5 will be considered in hydraulic connection with the aquifer and will be added to the groundwater sampling program.

2.2.5 Plant Well Decommissioning

Plant wells PP#1 through PP#9 will be decommissioned by a licensed well driller in accordance with Ecology regulations (Chapter 173-160 WAC, Minimum Standards for Construction and Maintenance of Wells).

2.3 Sampling Methodologies

2.3.1 Subsurface Soil Sampling

Subsurface soil quality samples will be collected from test pit explorations advanced using a backhoe or trackhoe following completion of pre-sampling explosives clearing program (where applicable). Site-specific sampling and installation depths for test pits are specified in Section 2.1. Cuttings from the test pits will be placed on the ground next to the excavation unless gross contamination is encountered (e.g., petroleum-saturated soils), in which case the cuttings will be placed on plastic sheeting and covered with plastic.

During excavation activities being conducted in nitroglycerin manufacturing, testing, or disposal areas, field personnel will be stationed a safe distance away from the area being excavated. In zones where anthropogenic features are encountered, or where directed by the on-site explosives expert, soils will be screened for the presence of explosives using EXPRAY[™] at approximately 2 to 3-foot-depth intervals. This will be accomplished by testing the soil in the backhoe/trackhoe bucket so that field personnel do not need to enter the excavation. Results of the colorimetric screening will be noted on the test pit field forms or notebook. If a strong color associated with the presence of nitroglycerin or other explosives is observed during colorimetric screening, excavation will be discontinued, access to the area will be restricted, and a plan will be developed to address the collection, disposal, and/or destruction of the explosive material (see EHA presented in Appendix C).

For test pits installed to depths of 3 feet or less, which are deemed safe for worker entry, sampling personnel may collect samples directly from the excavation side walls or bottom using clean stainless steel sampling equipment. For test pits advanced to depths greater than 3 feet, sampling personnel will not be allowed to enter the excavation. For these deeper test pits, soil samples will be collected directly from the backhoe or trackhoe bucket using a stainless steel spoon. Caution will be taken to sample soils from the middle of the bucket rather than soils in contact with the sides of the bucket. Care will also be taken to document from which depth interval soils in the bucket were from. Samples will be homogenized in a stainless steel bowl or within the bucket before being placed into pre-cleaned sample containers. Gravel-sized material greater than approximately 0.5 inch will be removed prior to placing soil into the sampling containers.

Subsurface soil samples collected from explosive manufacturing, testing, or disposal areas will be screened for the presence of explosives using EXPRAY[™].

Results of the colorimetric screening will be noted on the test pit sampling field forms or notebook. If a strong color is observed indicating the presence of high concentrations of explosive compounds, a notation will be placed on the sample chain of custody form and the laboratory will be notified at the time the samples are hand delivered.

Each test pit will be logged prior to being backfilled. The field representative will visually classify the soils in accordance with ASTM Method D 2488 and record soil descriptions and other relevant details (e.g., staining, debris, odors, etc.) in the field log. After sampling is completed, excavated soil from test pits will be backfilled into the same excavation. Test pit locations will be staked, labeled, and located using hand-held GPS.

2.3.2 Surface Soil Sampling

Surface soil sampling locations identified in Section 2.1 will be located in the field using hand-held GPS. Following removal of overlying duff, discrete samples will be collected from the upper 6 inches of soil. Samples will be collected using a shovel or trowel and placed in a stainless steel bowl for homogenization with a stainless steel spoon. Gravels larger than approximately 0.5 inch will be removed from the sample during mixing. A representative aliquot of the homogenized soil will be placed into certified-clean glass jars supplied by the analytical laboratory.

Surface soil samples collected from explosive manufacturing, testing, or disposal areas will be screened for the presence of explosives using EXPRAY™. Results of the colorimetric screening will be noted on the surface soil sampling field forms or notebook. If color associated with the presence of nitroglycerin or other explosives is observed, laboratory testing will be performed to confirm the presence of the explosive compounds (e.g., EPA Method 8330). If a strong color is observed indicating the presence of high concentrations of explosive compounds, a notation will be placed on the sample chain of custody form and the laboratory will be notified at the time the samples are hand delivered.

The field representative will visually classify the surface soils in accordance with ASTM Method D 2488 and record soil descriptions and other relevant details (e.g., staining, debris, odors, etc.) in the field log. After sampling is completed, surface soil sampling locations will be staked and labeled.

2.3.3 Monitoring Well Installation and Development

Four monitoring wells will be installed at locations identified in Section 2.2 using a hollow-stem auger drill rig. Prior to installing wells located in close proximity to former explosive manufacturing or disposal areas, test pits will be advanced to depths of 3 to 4 feet below ground surface at the proposed well locations to screen for the presence of explosive constituents. If suspect material is encountered, the well will be moved to an area with no evidence of explosive hazards. Test pits will be backfilled with excavated soil prior to installing each well.

The wells will consist of 2-inch-diameter PVC plastic well casings with 10-foot-long, 20-slot well screens. The wells screens will be placed across the water table. A sand pack will be installed from 1 foot below to 2 feet above the screened interval. The wells will be finished with a locking steel stick-up monument.

The new monitoring wells will be developed using a development pump and/or bailer. A minimum of 10 casing volumes of water will be removed during development, plus a volume equal to any water added during drilling. Water removed during development will be placed in labeled drums for subsequent characterization and disposal. Appropriate disposition of the development water will be determined based on the well sampling results. Wells will be allowed to stabilize for at least 24 hours before being sampled.

2.3.4 Groundwater Sampling

One round of groundwater samples will be collected from the 25 existing monitoring wells (assuming adequate groundwater recovery) and the four new wells. Groundwater samples will be collected with a peristaltic pump following low-flow sampling techniques to minimize suspended solids in the samples. Clean sample tubing will be used for each well and disposed of after use, and the tubing end will be positioned within the screen section throughout purging and sampling.

The field parameters temperature, pH, electrical conductivity, and dissolved oxygen will be measured and recorded periodically during purging of the well. Once the field parameters remain stable between measurements (i.e., specific conductivity ± 10 percent, pH ± 0.1 pH units, temperature $\pm 0.1^\circ$ C), the groundwater sample will be collected. Samples will be collected in laboratory-supplied sample containers directly from the pump discharge line at the same low rate used for purging.

Water removed during well purging will be placed in labeled drums pending analytical results, which will be used for subsequent characterization and disposal.

2.3.5 Groundwater Level Monitoring

The top of casing elevations for the four new wells will be surveyed. Groundwater elevation measurements will be obtained from the 29 wells and plotted to verify the groundwater flow direction.

2.4 Sample Documentation and Handling Procedures

Field Notebooks. While conducting field work at the site, the field representative will document pertinent observations and events on field sampling forms and logbook, and, when warranted, provide photographic documentation of specific sampling efforts. The logbook will contain a description of each field activity and associated details such as time, date, and field conditions. The logbook (a bound notebook) will be made from water-resistant paper with sequentially numbered pages.

Sample Labeling and Nomenclature. Sample labels will clearly indicate the sample number, date, sampler's initials, preservative added, if any, and any pertinent comments.

Chain of Custody Records. After collection, samples will be maintained in the consultant's custody until formally transferred to the analytical laboratory. For purposes of this work, custody will be defined as follows:

- In plain view of the field representatives;
- Inside a cooler that is in plain view of the field representative; or
- Inside any locked space such as a cooler, locker, car, or truck to which the field representative has the only immediately available key(s).

A chain of custody record will be initiated at the time of sampling for all samples collected. The record will be signed by the field representative and others who subsequently hold custody of the sample. Couriers or other professional shipping representatives are not required to sign the chain of custody form; however, shipping receipts will be collected and maintained as part of custody documentation in project files. A copy of the chain of custody with appropriate signatures will be kept by the project manager.

Sample Handling. Upon collection, samples will be placed upright in a cooler. Inert cushioning material will be placed on the bottom of the cooler. Ice will be placed in each cooler to maintain a temperature of 4° C to meet sample preservation requirements. Additionally, cushion material will be placed in the remaining space of the cooler. Paperwork (custody forms, cooler receipt form) will be placed in a waterproof bag and taped to the inside lid of the cooler.

Samples will be delivered to the analytical laboratory in a custody-sealed cooler. A signed custody seal will be placed over the lid of the cooler. Upon sample receipt, the laboratory will fill out a cooler receipt form to document sample delivery conditions. A designated sample custodian will accept custody of the shipped samples and will verify that the chain of custody form matches the samples received.

Samples that cannot be delivered to the laboratory by the field representative will be packaged as described above and shipped according to the following procedures:

- The lid will be secured by taping. The cooler will be wrapped completely with strapping tape at a minimum of two locations. Labels will not be covered with sealing tape;
- The completed shipping label will be attached to the top of the cooler; and
- Signed custody seals will be affixed to the front of the cooler.

2.5 Decontamination and Investigative-Derived Waste Procedures

All non-disposable sampling equipment (including stainless steel spoons and bowels) will be decontaminated before collection of each sample. The decontamination sequence consists of a scrub with a phosphorous detergent (Alconox) solution, followed by potable/tap water rinse, and finished with thorough spraying with deionized or distilled water. The drill rig augers will be steam cleaned prior to each exploration. Decontamination water will be containerized, characterized, and disposed of at an off-site facility.

The backhoe/trackhoe bucket will be decontaminated between each area of investigation using a steam cleaner or pressure washer. Rinsate water generated from backhoe/trackhoe bucket decontamination will be directed into the associated test pits.

Development and purge water will be containerized in labeled 55-gallon drums. Appropriate disposition of the water will be determined based on well sample analytical results. Soil cuttings generated from the installation of the four new

monitoring wells will be containerized in 55-gallon drums. A composite sample will be collected from the drummed soil cuttings for analysis to determine appropriate disposition of the soil. One composite sample will be collected from each drum of soil cuttings generated and tested for the same analytes that the corresponding groundwater sample is analyzed. The analytical results will be used to characterize the soil cuttings for appropriate disposition.

Drums of decontamination and purge water will be stored inside the Culvert Plant warehouse or storage buildings. Drummed soil cuttings generated during the Site-Wide Phase II will be moved to the same location and characterized for disposition.

Table 2-1 - Planned Soil Quality Samples and Analyses

Area of Potential Concern	Number of Samples	Analytes									
		As	Pb	Hg	METALS	NG	NA/NA	CHLORINATED HERBICIDES	TPH	PCBs	PAHs
Narrow Gauge RR	63	63	63					3			
Standard Gauge RR	30	30	30					3			
Old Nitrator Excavation	1 per 500 cy	x	x			x					
Old Nitrator	50	24	47			26		3			
New Nitrator	20	20	20								
Mix Excavation	1 per 500 cy	x	x			x					
Mix/DNT/NC Houses	25	15	25			5	10	3			
Magazines	13	13	13					1			
Laboratories	13	8	13	13							
Farm Burn Pit	5				5		5			5	5
Seismic Pond											
Trailer Storage	28	28	28						28		
Area-Wide Surface Soil	125	125	125								
Soil Duplicates		11	11	1	1	2	1	1	2	1	1
TOTAL SAMPLES	372	337	375	14	6	33	16	14	30	6	6

Notes:

As/Pb - Total Arsenic and Lead

Metals - Total Metals including As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn

NG - Nitroglycerin

NA/NA - Nitroaromatics and Nitroamines

TPH - Total Petroleum Hydrocarbons

PCBs - Polychlorinated Biphenyls

PAHs - Polycyclic Aromatic Hydrocarbons

Old Nitrator and Mix House explosives clearing excavation sampling will be conducted at a frequency of one sample per 500 cubic yards of stockpiled soil.

Table 2-2 - Groundwater Quality Samples and Analyses

Monitoring Well Designation	WELL LOCATION	Number of Samples											
			TPH-G	TPH-DX	VOA	METALS	NA/NA	SVOA	INORG	NG	PCL	GLYCOL	TSS
MP-MW1 thru MP-MW3	MEAN PLANT	3	3	3	3	3			3				3
ABS-MW1	ABS LANDFILL	1	1	1	1	1	1	1	1		1		1
HC-MW-1 thru HC-MW-6	DRUM BURIAL AREA	6				6	6						6
PP-MW1 thru PP-MW6	POWDER PLANT	6	6	6	6	6	6	6	6		6	6	6
MH-MW1	MIX HOUSE	1				1	1		1	1	1	1	1
DMH-MW1	DNT MELT HOUSE	1				1	1		1	1	1	1	1
ON-MW1 thru ON-MW3	OLD NITRATOR	3				3			3	3		3	3
NH-MW1	NEUTRALIZER HOUSE	1				1			1	1		1	1
NN-MW1 thru NN-MW5	NEW NITRATOR	5				5			5	5		5	5
SP-WP1	SEISMIC POND	1	1	1		1	1		1	1	1		1
CY-MW1 thru CY-MW2	CULVERT YARD	2	2	2	2	2		2	2				2
Water Duplicate		2	1	1	1	2	1	1	2	1	1	1	2
TOTAL SAMPLES		32	14	14	13	32	17	10	26	13	11	18	32

Notes:

VOA - Volatile Organics

NA/NA - Nitroaromatics and Nitroamines

Metals - Dissolved (filtered) metals including As, Cd, Cr, Cu, Hg, Pb, Ni, and Zn

SVOA - Semivolatile Organics

INORG - Inorganics including nitrate, ammonia, sulfate, sodium, and chloride

NG - Nitroglycerin

PCL - Perchlorate

3.0 QUALITY ASSURANCE PROJECT PLAN

The purpose of this Quality Assurance Project Plan (QAPP) is to define, in specific terms, the quality assurance (QA) and quality control (QC) objectives, organization, and functional activities associated with the sampling and analysis of soil and groundwater samples obtained during this investigation.

3.1 Analytical Procedures

Analyses for soil and groundwater samples will be performed in accordance with the methods specified in Tables 3-1 and 3-2, respectively. Severn Trent Laboratories (STL) will analyze the project samples. The address and contact for the laboratory is:

Severn Trent Laboratories
5755 8th Street East
Tacoma, WA 98424
Contact: Dawn Werner (253) 922-2310

The laboratory typically achieves the reporting limits (RLs) presented in Tables 3-1 and 3-2 for the methods defined. The RL is defined as the lowest reproducible concentration at which a chemical can be accurately and reproducibly quantified for a given sample. The RL can vary from sample to sample depending on sample size, matrix interferences, moisture content, and other sample-specific conditions. The RLs usually correspond to the lowest calibration standard. In general, RLs will reflect the lowest concentration that an analyte can be accurately and reproducibly detected at by the analytical method employed.

The RLs will be sufficiently below MTCA cleanup levels, as presented in Tables 3-1 and 3-2, with the exception of 2,4-dinitrotoluene, and 2,6-dinitrotoluene for soil, and 2,4-dinitrotoluene, 2,6-dinitrotoluene, 1,1,2,2-tetrachloroethane, 1,2,3-trichloropropane, 1,2-dibromo-3-chloropropane, cis-1,3-dichloropropene, trans-1,3-dichloropropene, vinyl chloride, 1,2-diphenylhydrazine, benzidine, bis(2-chloroethyl)ether, hexachlorobenzene, n-nitrosodimethylamine, and n-nitroso-di-n-propylamine for groundwater. Excluding 2,4- and 2,6-dinitrotoluene, none of these compounds have been identified as being manufactured or used at the site and are not considered constituents of potential concern.

3.2 Data Quality Indicators

Data quality indicators (DQIs), including precision, accuracy, representativeness, comparability, and completeness (PARCC parameters), and data RLs are dictated by the data quality objectives, project requirements, and intended uses of the data. The data must be of sufficient technical quality to determine whether contaminants are present and whether they pose a potential threat to human health and the environment.

An assessment of data quality is based upon quantitative (precision, accuracy, and completeness) and qualitative (representativeness and comparability) indicators. Definitions of these parameters and the applicable QC procedures are given below.

3.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared with their average values. Analytical precision is measured through matrix spike/matrix spike duplicate (MS/MSD) samples and laboratory control samples/laboratory control sample duplicate (LCS/LCSD) for organic analysis and through duplicate samples for inorganic analyses. Analytical precision is quantitatively expressed as the relative percent difference (RPD) between the LCS/LCSD, MS/MSD, or duplicates. Analytical precision measurements will be carried out at a minimum frequency of one per laboratory analysis group. Laboratory precision will be evaluated against laboratory quantitative RPD performance criteria presented in Appendix B.

Field duplicates will be carried out at a minimum frequency of 5 percent per analytical group.

3.2.2 Accuracy

Accuracy measures the closeness of the measured value to the true value. The accuracy of chemical test results is assessed by "spiking" samples with known standards (surrogates, blank spikes, or matrix spikes) and establishing the average recovery. Accuracy measurements on MS samples will be carried out at a minimum frequency of one in twenty samples per matrix analyzed. Blank spikes will also be analyzed at a minimum frequency of one in twenty samples per matrix analyzed. Surrogate recoveries will be determined for every sample analyzed for organics. Laboratory accuracy will be evaluated against

quantitative matrix spike and surrogate spike recovery performance criteria as presented in Appendix B.

3.2.3 Representativeness

Representativeness measures how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the matrix sampled. The sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) have been developed to ensure representative samples.

3.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard techniques for both sample collection and laboratory analysis should make data collected comparable to both internal and other data generated.

3.2.5 Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. Results will be considered valid if all the precision, accuracy, and representativeness objectives are met and if RLs are sufficient for the intended uses of the data. The target completeness goal for this project is 95 percent.

Laboratory internal QC checks, preventive maintenance, and corrective action, as described in other sections of this document, will be implemented to help meet the QA objectives established for these analyses.

3.3 Quality Control Procedures

The following QC procedures will be followed.

3.3.1 Field Quality Control

Field QC procedures for this project will consist of the following:

- Field duplicates will be collected at a minimum of 5 percent per matrix sampled and chemistry analytical method performed;
- Temperature blanks will be included with each shipped cooler; and

- Trip blanks will be included with each cooler containing samples for volatile organics analysis.

3.3.2 Laboratory Quality Control

The laboratory's QC officers are responsible for ensuring that the laboratory implements all routine internal QA and QC procedures.

The laboratory QC procedures used for this project will consist of the following at a minimum:

- Instrument calibration and standards as defined in the laboratory standard operating procedures (SOPs);
- Laboratory blank measurements at a minimum frequency of 5 percent or one per twenty samples; and
- Accuracy and precision measurements as defined above, at a minimum frequency of 5 percent or one per twenty samples per matrix, or one in ten samples per matrix for blind duplicates.

3.4 Corrective Actions

If routine QC audits by the laboratory result in detection of unacceptable conditions or data, actions specified in the laboratory SOPs will be taken. Specific corrective actions are outlined in each SOP used and include but are not limited to the following:

- Identifying the source of the violation;
- Reanalyzing samples if holding time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and/or
- Accepting data and flagging to indicate the level of uncertainty.

If unacceptable conditions occur, the laboratory will contact the Project QA Officer to discuss the issues and determine the appropriate corrective action. All corrective actions taken by the laboratory during analysis of samples for this project will be documented by the laboratory in the case narrative associated with the impacted samples.

3.5 Data Reduction, Quality Review, and Reporting

All data will undergo two levels of QA/QC evaluation: one at the laboratory, and one by a validator independent of the laboratory. Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols. Quality control data resulting from methods and procedures described in this document will also be reported.

3.5.1 Minimum Data Reporting Requirements

The following sections describe the minimum data reporting requirements necessary to ensure sufficient reporting of analytical data to allow proper QA/QC reporting.

Sample Receipt. Cooler receipt forms will be supplied to the laboratories to be filled out for all sample shipments to document problems in sample packaging, chain of custody, and sample preservation.

Reporting. For each analytical method run, analytes for each sample will be reported as a detected concentration or as less than the specific reporting limit. Solid samples will be reported on a dry weight basis. The laboratories will also report dilution factors for each sample as well as date of extraction (if applicable), date of analysis, extraction method, any cleanup methods performed, and confirmation results where required.

Internal Quality Control Reporting. Internal quality control samples will be analyzed at the rates specified in the applicable analytical method.

- **Laboratory Blanks.** Analytes will be reported for each laboratory blank. Non-blank sample results shall be designated as corresponding to a particular laboratory blank in terms of analytical batch processing.
- **Surrogate Spike Samples.** Surrogate spike recoveries will be reported with all organic reports where appropriate. The report shall also specify the control limits for surrogate spike results as well as the spiking concentration. Out of control recoveries (as defined in the Method Compendium) will be reported immediately to the Project QA Officer. Out of control recoveries (as defined in the method) will result in the sample being rerun (both sets of data are to be reported).
- **Matrix Spike Samples.** Matrix spike recoveries will be reported for organic and inorganic analyses. General sample results will be designated as

corresponding to a particular matrix spike sample. The report will indicate which sample was spiked and the spike concentration. The report will also specify the control limits for matrix spike results for each method and matrix.

- **Laboratory Duplicates and/or Matrix Spike Duplicate Pairs.** Relative percent differences will be reported for duplicate pairs as well as analyte/matrix-specific control limits.
- **Laboratory Control Samples (LCS).** LCS recoveries will be reported for organic analyses. LCS results and control limits will be reported with the corresponding sample data.

3.5.2 Quality Review

Reported analytical results will be qualified by the laboratory to identify QC concerns in accordance with the specifications of the analytical methods. Additional laboratory data qualifiers may be defined and reported by the laboratory to more completely explain QC concerns regarding a particular sample result. All additional data qualifiers will be defined in the laboratory's narrative reports associated with each case.

A data quality review summary will be produced for this project and included in the final construction report. Data quality review will be performed in accordance with EPA National Functional Guidelines (EPA 1999) with regard to the following, as appropriate to the particular analysis:

- Sample documentation/custody;
- Holding times;
- Method and trip blanks (representativeness);
- Reporting limits;
- Laboratory and field duplicate RPDs (precision);
- Blank spike, matrix spike, and surrogate percent recoveries (accuracy);
- Comparability;
- Completeness; and
- Data report formats.

3.6 Preventive Maintenance Procedures and Schedules

Preventive maintenance in the laboratory will be the responsibility of the laboratory personnel and analysts. This maintenance includes routine care and cleaning of instruments, and inspection and monitoring of carrier gases, solvents,

and glassware used in analyses. Details of the maintenance procedures are addressed in the laboratory SOPs.

Precision and accuracy data are examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to change as indicated by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet one or another of the method-specific QC criteria.

3.7 Performance and System Audits

The Project QA Officer will monitor the performance of the laboratory QA program. This will be achieved through regular contact with the analytical laboratory's QA staff.

To ensure comparable data, all samples of a given matrix to be analyzed by each specified analytical method will be processed consistently by the same analytical laboratory.

3.8 QC Reports to Management

A quality assurance summary report will be included in the final RI/FS report. The summary will include the evaluation of the data in accordance with data quality objectives, and will include discussions on precision, accuracy, representativeness, completeness, comparability, and reporting limits.

3.9 References for Section 3

EPA 1999. USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review, October 1999.

Table 3-1 - Comparison of Soil Reporting Limit Goals to Preliminary Screening Criteria

	MTCA Soil Screening Levels					
	Human Health		Ecological (W)	PQL	Reporting Limit	Analytical Method
Total Metals in mg/kg						
Arsenic (III/IV)	20	A	132	2.5	1.25	EPA Method 6010
Cadmium	2	A	14	1	0.5	EPA Method 6010
Chromium (assumed III)	2,000	A	67	2	1	EPA Method 6010
Copper	260	GW	217	2	1	EPA Method 6010
Lead	250	A	118	2	1	EPA Method 6010
Mercury	2	A	5.5		0.01	EPA Method 7471
Nickel	420	GW	980	2	1	EPA Method 6010
Zinc	6,000	GW	360	2	1	EPA Method 6010
Nitroaromatics and Nitroamines in mg/kg						
Nitroglycerin	71.4	S	--		0.1	EPA Method 8330
HMX	4,000	S	--	0.05	0.025	EPA Method 8330
1,3,5-Trinitrobenzene	2,400	S	--	0.1	0.05	EPA Method 8330
RDX	9.1	S	--	0.05	0.025	EPA Method 8330
1,3-Dinitrobenzene	8	S	--	0.05	0.025	EPA Method 8330
Nitrobenzene	0.05	GW	--	0.05	0.025	EPA Method 8330
2,4,6-Trinitrotoluene	33	S	--	0.1	0.05	EPA Method 8330
Tetryl	800	S	--	0.2	0.1	EPA Method 8330
2,4-Dinitrotoluene	0.0008	GW	--	0.1	0.05	EPA Method 8330
2,6-Dinitrotoluene	0.0007	GW	--	0.1	0.05	EPA Method 8330
2-Am-DNT	--	--	--	0.1	0.05	EPA Method 8330
4-Am-DNT	--	--	--	0.1	0.05	EPA Method 8330
2-Nitrotoluene	800	S	--	0.1	0.05	EPA Method 8330
3-Nitrotoluene	800	S	--	0.1	0.05	EPA Method 8330
4-Nitrotoluene	800	S	--	0.1	0.05	EPA Method 8330
Chlorinated Herbicides and PCP in mg/kg						
2,4,5-T	800	S	--	0.0167	0.00835	EPA Method 8151
2,4-D	800	S	--	0.0167	0.00835	EPA Method 8151
2,4-DB	640	S	--	0.0167	0.00835	EPA Method 8151
4-Nitrophenol	--	--	--	0.0334	0.0167	EPA Method 8151
Dalapon	2,400	S	--	0.0167	0.00835	EPA Method 8151
Dicamba	2,400	S	--	0.0167	0.00835	EPA Method 8151
Dichloroprop	--	--	--	0.0167	0.00835	EPA Method 8151
Dinoseb	80	S	--	0.0167	0.00835	EPA Method 8151
MCPA	40	S	--	0.0167	0.00835	EPA Method 8151
MCPP	80	S	--	0.0167	0.00835	EPA Method 8151
Pentachlorophenol	0.012	GW	4.5	0.0167	0.00835	EPA Method 8151
Picloram	5,600	S	--	0.0167	0.00835	EPA Method 8151
Silvex (2,4,5-TP)	640	S	--	0.0167	0.00835	EPA Method 8151
Total Petroleum Hydrocarbon in mg/kg						
Diesel Range	2,000	A	6,000	25		NWTPH-Dx
Oil Range	2,000	A	--	50		NWTPH-Dx
PCBs in mg/kg						
Aroclor 1016	1	A	0.65	0.01	0.005	EPA Method 8082
Aroclor 1221	1	A	0.65	0.01	0.005	EPA Method 8082
Aroclor 1232	1	A	0.65	0.01	0.005	EPA Method 8082
Aroclor 1242	1	A	0.65	0.01	0.005	EPA Method 8082
Aroclor 1248	1	A	0.65	0.01	0.005	EPA Method 8082
Aroclor 1254	1	A	0.65	0.01	0.005	EPA Method 8082
Aroclor 1260	1	A	0.65	0.01	0.005	EPA Method 8082
PAHs in mg/kg						
Acenaphthene	98	GW		0.01	0.005	EPA Method 8270C
Acenaphthylene	98	GW	--	0.01	0.005	EPA Method 8270C
Anthracene	1,140	GW	--	0.01	0.005	EPA Method 8270C
Benzo(a)Anthracene	See benzo(a)pyrene	A	--	0.01	0.005	EPA Method 8270C
Benzo(a)Pyrene	0.1	A	12	0.01	0.005	EPA Method 8270C
Benzo(g,h,i)Perylene	655	GW	--	0.01	0.005	EPA Method 8270C
Benzofluoranthenes	See benzo(a)pyrene	A	--	0.01	0.025	EPA Method 8270C
Chrysene	See benzo(a)pyrene	A	--	0.01	0.005	EPA Method 8270C
Dibenz(a,h)Anthracene	See benzo(a)pyrene	A	--	0.01	0.005	EPA Method 8270C
Fluoranthene	631	GW	--	0.01	0.005	EPA Method 8270C
Fluorene	101	GW		0.01	0.005	EPA Method 8270C
Indeno(1,2,3-cd)Pyrene	See benzo(a)pyrene	A	--	0.01	0.005	EPA Method 8270C
Naphthalene	4.5	GW	--	0.01	0.005	EPA Method 8270C
Phenanthrene	1,140	GW	--	0.01	0.005	EPA Method 8270C
Pyrene	655	GW	--	0.01	0.005	EPA Method 8270C

Notes

- A MTCA Method A
- GW MTCA Method B Protection to Groundwater
- S MTCA Method B Soil Ingestion
- (W) Based on MTCA Table 749-3 Ecological Indicator Soil Concentrations for protection of wildlife

Table 3-2 - Comparison of Groundwater Reporting Limit Goals to Preliminary Screening Criteria

	MTCA Groundwater Screening Levels ^a	PQLs	Reporting Limit	Analytical Method
Conventionals in mg/L				
TSS	--	10	--	EPA Method 160.2
Nitrate	--	0.03	0.015	EPA Method 300.0
Sulfate	--	0.3	0.15	EPA Method 300.0
Chloride	--	0.3	0.15	EPA Method 300.0
Sodium	--	1.5	0.75	EPA Method 6010
Ammonia	--			EPA Method 350.2
Dissolved Metals in mg/L				
Arsenic	0.005	0.001	0.0005	EPA Method 6020
Cadmium	0.005	0.0005	0.00025	EPA Method 6020
Chromium (assumed III)	0.1	0.001	0.0005	EPA Method 6020
Copper	0.59	0.001	0.0005	EPA Method 6020
Mercury	0.002	0.0002	0.0001	EPA Method 7470
Nickel	0.32	0.001	0.0005	EPA Method 6020
Zinc	4.8	0.003	0.0015	EPA Method 6020
Total Petroleum Hydrocarbon in mg/L				
Gasoline Range	0.8	0.1	0.05	NWTPH-Gx
Diesel Range	0.5	0.2	0.15	NWTPH-Dx
Oil Range	0.5	0.4	0.2	NWTPH-Dx
Nitroaromatics and Nitroamines in ug/L				
Nitroglycerin	6.3		0.65	EPA Method 8330
HMX	800	1	0.5	EPA Method 8330
1,3,5-Trinitrobenzene	240	0.5	0.25	EPA Method 8330
RDX	0.8	0.5	0.25	EPA Method 8330
1,3-Dinitrobenzene	0.8	0.4	0.2	EPA Method 8330
Nitrobenzene	8	1	0.5	EPA Method 8330
2,4,6-Trinitrotoluene	2.9	1	0.5	EPA Method 8330
Tetryl	80	2	1	EPA Method 8330
2,4-Dinitrotoluene	0.13	1	0.5	EPA Method 8330
2,6-Dinitrotoluene	0.13	0.5	0.25	EPA Method 8330
2-Am-DNT	--	1	0.5	EPA Method 8330
4-Am-DNT	--	2	1	EPA Method 8330
2-Nitrotoluene	160	1	0.5	EPA Method 8330
3-Nitrotoluene	160	1	0.5	EPA Method 8330
4-Nitrotoluene	160	1	0.5	EPA Method 8330
Glycols in mg/L				
Ethylene Glycol	32,000	10	5	EPA Method 8015
Propylene Glycol	8,000	10	5	EPA Method 8015
Perchlorate in ug/L				
Perchlorate	1.6		4	EPA Method 314

Table 3-2 - Comparison of Groundwater Reporting Limit Goals to Preliminary Screening Criteria

	MTCA Groundwater Screening Levels ^a	PQLs	Reporting Limit	Analytical Method
VOAs in ug/L				
1,1,1,2-Tetrachloroethane	1.7	1	0.5	EPA Method 8260B
1,1,1-Trichloroethane	200	1	0.5	EPA Method 8260B
1,1,2,2-Tetrachloroethane	0.22	1	0.5	EPA Method 8260B
1,1,2-Trichloroethane	0.77	1	0.5	EPA Method 8260B
1,1-Dichloroethane	800	1	0.5	EPA Method 8260B
1,1-Dichloroethene	400	1	0.5	EPA Method 8260B
1,1-Dichloropropene	--	1	0.5	EPA Method 8260B
1,2,3-Trichlorobenzene	--	1	0.5	EPA Method 8260B
1,2,3-Trichloropropane	0.022	1	0.5	EPA Method 8260B
1,2,4-Trichlorobenzene	80	1	0.5	EPA Method 8260B
1,2,4-Trimethylbenzene	400	1	0.5	EPA Method 8260B
1,2-Dibromo-3-chloropropane	0.03	1	0.5	EPA Method 8260B
1,2-Dichlorobenzene	720	1	0.5	EPA Method 8260B
1,2-Dichloroethane	5	1	0.5	EPA Method 8260B
1,2-Dichloropropane	1	1	0.5	EPA Method 8260B
1,3,5-Trimethylbenzene	400	1	0.5	EPA Method 8260B
1,3-Dichlorobenzene	7.2	1	0.5	EPA Method 8260B
1,3-Dichloropropane	--	1	0.5	EPA Method 8260B
1,4-Dichlorobenzene	1.8	1	0.5	EPA Method 8260B
2,2-Dichloropropane	--	1	0.5	EPA Method 8260B
2-Butanone	4,800	5	2.5	EPA Method 8260B
2-Chlorotoluene	160	1	0.5	EPA Method 8260B
2-Hexanone	--	5	2.5	EPA Method 8260B
4-Chlorotoluene	--	1	0.5	EPA Method 8260B
4-Isopropyltoluene	--	1	0.5	EPA Method 8260B
4-Methyl-2-pentanone	640	5	2.5	EPA Method 8260B
Acetone	7200	5	2.5	EPA Method 8260B
Benzene	5	1	0.5	EPA Method 8260B
Bromobenzene	160	1	0.5	EPA Method 8260B
Bromochloromethane	--	1	0.5	EPA Method 8260B
Bromodichloromethane	0.71	1	0.5	EPA Method 8260B
Bromoform	5.5	1	0.5	EPA Method 8260B
Bromomethane	11	2.5	1.25	EPA Method 8260B
Carbon disulfide	800	1	0.5	EPA Method 8260B
Carbon Tetrachloride	0.34	1	0.5	EPA Method 8260B
Chlorobenzene	160	1	0.5	EPA Method 8260B
Chloroethane	15	1	0.5	EPA Method 8260B
Chloroform	7	1	0.5	EPA Method 8260B
Chloromethane	3.4	2	1	EPA Method 8260B
cis-1,2-Dichloroethene	80	1	0.5	EPA Method 8260B
cis-1,3-Dichloropropene	0.44	1	0.5	EPA Method 8260B
Dibromochloromethane	0.52	1	0.5	EPA Method 8260B
Dibromomethane	80	1	0.5	EPA Method 8260B
Dichlorodifluoromethane	1600	1	0.5	EPA Method 8260B
Ethylbenzene	700	1	0.5	EPA Method 8260B
Hexachlorobutadiene	1.1	1	0.5	EPA Method 8260B
Isopropylbenzene	800	1	0.5	EPA Method 8260B

Table 3-2 - Comparison of Groundwater Reporting Limit Goals to Preliminary Screening Criteria

	MTCA Groundwater Screening Levels ^a	PQLs	Reporting Limit	Analytical Method
VOAs in ug/L (continued)				
m,p-Xylene	1000	2	1	EPA Method 8260B
Methylene chloride	5	2	1	EPA Method 8260B
Naphthalene	160	2	1	EPA Method 8260B
n-Butylbenzene	320	1	0.5	EPA Method 8260B
n-Propylbenzene	320	1	0.5	EPA Method 8260B
o-Xylene	1000	1	0.5	EPA Method 8260B
sec-Butylbenzene	320	1	0.5	EPA Method 8260B
Styrene	1600	1	0.5	EPA Method 8260B
t-Butylbenzene	320	1	0.5	EPA Method 8260B
Tetrachloroethene	5	1	0.5	EPA Method 8260B
Toluene	1000	1	0.5	EPA Method 8260B
trans-1,2-Dichloroethene	160	1	0.5	EPA Method 8260B
trans-1,3-Dichloropropene	0.44	1	0.5	EPA Method 8260B
Trichloroethene	5	1	0.5	EPA Method 8260B
Trichlorofluoromethane	2400	1	0.5	EPA Method 8260B
Vinyl chloride	0.2	1	0.5	EPA Method 8260B
SVOAs in ug/L				
1,2,4-Trichlorobenzene	80	1	0.5	EPA Method 8270C
1,2-Dichlorobenzene	720	1	0.5	EPA Method 8270C
1,2-Diphenylhydrazine	0.11	1	0.5	EPA Method 8270C
1,3-Dichlorobenzene	7.2	1	0.5	EPA Method 8270C
1,4-Dichlorobenzene	1.8	1	0.5	EPA Method 8270C
1-Methylnaphthalene	160	1	0.5	EPA Method 8270C
2,3,4,6-Tetrachlorophenol	480	1	0.5	EPA Method 8270C
2,3,5,6-Tetrachlorophenol	--	1.5	0.75	EPA Method 8270C
2,3-Dichloroaniline	--	1	0.5	EPA Method 8270C
2,4,5-Trichlorophenol	1,600	1	0.5	EPA Method 8270C
2,4,6-Trichlorophenol	1.6	1	0.5	EPA Method 8270C
2,4-Dichlorophenol	48	1	0.5	EPA Method 8270C
2,4-Dimethylphenol	320	5	2.5	EPA Method 8270C
2,4-Dinitrophenol	32	5	2.5	EPA Method 8270C
2,4-Dinitrotoluene	0.13	1	0.5	EPA Method 8270C
2,6-Dinitrotoluene	0.13	1	0.5	EPA Method 8270C
2-Chloronaphthalene	640	1	0.5	EPA Method 8270C
2-Chlorophenol	40	1	0.5	EPA Method 8270C
2-Methylnaphthalene	160	0.3	0.15	EPA Method 8270C
2-Methylphenol	800	1	0.5	EPA Method 8270C
2-Nitroaniline	0.46	1	0.5	EPA Method 8270C
2-Nitrophenol	--	1	0.5	EPA Method 8270C
3-&4-Methylphenol	80	2	1	EPA Method 8270C
3,3'-Dichlorobenzidine	0.19	5	2.5	EPA Method 8270C
3-Nitroaniline	--	1	0.5	EPA Method 8270C
4,6-Dinitro-2-methylphenol	--	5	2.5	EPA Method 8270C
4-Bromophenylphenylether	--	1	0.5	EPA Method 8270C
4-Chloro-3-methylphenol	--	1	0.5	EPA Method 8270C
4-Chloroaniline	64	1.5	0.75	EPA Method 8270C
4-Chlorophenylphenylether	--	1	0.5	EPA Method 8270C

Table 3-2 - Comparison of Groundwater Reporting Limit Goals to Preliminary Screening Criteria

	MTCA Groundwater Screening Levels ^a	PQLs	Reporting Limit	Analytical Method
SVOAs in ug/L (Continued)				
4-Nitroaniline	--	1	0.5	EPA Method 8270C
4-Nitrophenol	--	5	2.5	EPA Method 8270C
Acenaphthene	960	0.25	0.125	EPA Method 8270C
Acenaphthylene	960	0.3	0.15	EPA Method 8270C
Acetophenone	--	1	0.5	EPA Method 8270C
Aniline	15	1.5	0.75	EPA Method 8270C
Anthracene	2400	1	0.5	EPA Method 8270C
Benzaldehyde	1600	1.5	0.75	EPA Method 8270C
Benzidine	0.00038	5	2.5	EPA Method 8270C
Benzo(a)anthracene	see benzo(a)pyrene	0.1	0.05	EPA Method 8270C
Benzo(a)pyrene	0.1	0.1	0.05	EPA Method 8270C
Benzo(g,h,i)perylene	480	1	0.5	EPA Method 8270C
Benzo(a)fluoranthene	see benzo(a)pyrene	0.2	0.1	EPA Method 8270C
Benzoic Acid	64,000	5	2.5	EPA Method 8270C
Benzyl Alcohol	4,800	1	0.5	EPA Method 8270C
Biphenyl	800	1	0.5	EPA Method 8270C
bis(2-Chloroethoxy)methane	--	1	0.5	EPA Method 8270C
bis(2-Chloroethyl)ether	0.04	1	0.5	EPA Method 8270C
bis(2-Chloroisopropyl)ether	0.63	1	0.5	EPA Method 8270C
bis(2-Ethylhexyl)phthalate	6.3	7.5	3.75	EPA Method 8270C
Butylbenzylphthalate	3,200	1.5	0.75	EPA Method 8270C
Carbazole	4.4	1	0.5	EPA Method 8270C
Chrysene	see benzo(a)pyrene	1	0.5	EPA Method 8270C
Cyclohexanone	80,000	2	1	EPA Method 8270C
Decane	--	1	0.5	EPA Method 8270C
Dibenz(a,h)anthracene	see benzo(a)pyrene	0.2	0.1	EPA Method 8270C
Dibenzofuran	32	1	0.5	EPA Method 8270C
Diethylphthalate	13,000	1	0.5	EPA Method 8270C
Dimethylphthalate	160,000	1	0.5	EPA Method 8270C
Di-n-butylphthalate	1,600	1	0.5	EPA Method 8270C
Di-n-octylphthalate	640	1	0.5	EPA Method 8270C
Fluoranthene	640	0.2	0.1	EPA Method 8270C
Fluorene	640	0.2	0.1	EPA Method 8270C
Hexachlorobenzene	0.055	1	0.5	EPA Method 8270C
Hexachlorobutadiene	1.1	1	0.5	EPA Method 8270C
Hexachlorocyclopentadiene	96	5	2.5	EPA Method 8270C
Hexachloroethane	6.3	1	0.5	EPA Method 8270C
Indeno(1,2,3-cd)pyrene	see benzo(a)pyrene	0.2	0.1	EPA Method 8270C
Isophorone	92	1	0.5	EPA Method 8270C
Naphthalene	160	0.3	0.15	EPA Method 8270C
Nitrobenzene	8	1	0.5	EPA Method 8270C
N-nitrosodimethylamine	0.0017	5	2.5	EPA Method 8270C
N-nitroso-di-n-propylamine	0.013	1	0.5	EPA Method 8270C
N-Nitrosodiphenylamine	18	1	0.5	EPA Method 8270C
Octadecane	--	1	0.5	EPA Method 8270C
Pentachlorophenol ^b	0.73	0.325	0.16	EPA Method 8270C
Phenanthrene	2,400	0.1	0.05	EPA Method 8270C

Table 3-2 - Comparison of Groundwater Reporting Limit Goals to Preliminary Screening Criteria

	MTCA Groundwater Screening Levels ^a	PQLs	Reporting Limit	Analytical Method
SVOAs in ug/L (Continued)				
Phenol	4,800	1	0.5	EPA Method 8270C
Pyrene	480	0.1	0.05	EPA Method 8270C
Pyridine	160	5	2.5	EPA Method 8270C

Notes

^a Screening criteria based on MTCA Method A and B drinking water standards

^b Low level analysis. Only applicable to samples with limited contamination, otherwise PQL of 3.25 µg/L applies.

Table 3-3 - Sample Container, Preservative, and Holding Times

Matrix	Chemical Analysis	Sample Container ^{a,b,c}	Preservative ^d	Holding Time
Soil				
	Total Metals except Mercury	4 oz soil jar	Cool 4°C	6 months
	Total Mercury	4 oz soil jar	Cool 4°C	28 days
	TPH-Dx	4 oz soil jar	Cool 4°C	14 days/40 days
	NA/NA with Nitroglycerin	3 oz soil jar	Cool 4°C	14 days/40 days
	Chlorinated Herbicides	4 oz soil jar	Cool 4°C	7 days/40 days
	PCBs	5 oz soil jar	Cool 4°C	14 days/40 days
	PAHs	4 oz soil jar	Cool 4°C	14 days/40 days
Water				
	Inorganics except Nitrate	125mL HDPE	Cool 4°C	28 days
	Nitrate	125mL HDPE	Cool 4°C	48 hours
	TSS	1L HDPE	Cool 4°C	7 days
	Dissolved Metals except Mercury	250mL HDPE	HNO ³ - pH<2	6 months
	Dissolved Mercury	250mL HDPE	HNO ³ - pH<2	28 days
	TPH-Gx	3-40mL VOA Vials	HCl - pH<2	14 days
	TPH-Dx	125mL Amber	HCl - pH<2	7 days/40 days
	VOAs	3-40mL VOA Vials	HCl - pH<2	14 days
	SVOAs	1 L Amber	Cool 4°C	7 days/40 days
	Glycols	3-40mL VOA Vials	Cool 4°C	7 days/40 days
	NA/NA with Nitroglycerin	1 L Amber	Cool 4°C	7 days/40 days

Notes

NA/NA - Nitroaromatics and Nitroamines

PCBs - Polychlorinated Biphenyls

PAHs - Polycyclic Aromatic Hydrocarbons

^a TLC G = Teflon-lined screw cap glass.

^b TLS G = Teflon-lined septa xonically bonded to screw cap glass.

^c HDPE = High Density Polyethylene

^d Samples shall be maintained at 4°C +/- 2°C.

^e Holding time until extraction/until analysis.

4.0 HEALTH AND SAFETY PLAN

4.1 Emergency Contingency Information

SITE LOCATION	Former Pacific Powder Site 13120 Tilly Road South Olympia, Washington
NEAREST HOSPITAL	Providence St. Peter Hospital 413 Lilly Road, NE Olympia, Washington (360) 491-9480 The route from the facility to the hospital is depicted on Figure 4-1.
EMERGENCY RESPONDERS	Police Department911 Fire Department911 Ambulance.....911
EMERGENCY CONTACTS	Aspect Consulting, Seattle Office(206) 328-7443 Jay Allen, Allen and Co., LLC.....(206) 919-8100 Xinguo Sun, Citifor(206) 622-3770
IN EVENT OF EMERGENCY, CALL FOR HELP AS SOON AS POSSIBLE	Give the following information: ➔ Where You Are. Address, cross streets, or landmarks ☎ Phone Number you are calling from ?? What Happened. Type of injury, accident # How many persons need help ?? What is being done for the victim(s) !! You hang up last. Let whomever you called hang up first

Figure 4-1

REPLACE PAGE

4.2 Site Health and Safety Plan Summary

SITE NAME: Former Pacific Powder Site

LOCATION: 13120 Tilly Road South, Olympia, Washington

CLIENT: Citifor/Allen and Company, LLC

PROPOSED DATES OF ACTIVITIES: June 2004 through June 2005.

TYPE OF FACILITY: Former explosive manufacturing site.

LAND USE OF AREA SURROUNDING FACILITY: Rural/Residential

SITE ACTIVITIES:

- Pre-sampling explosives clearing program;
- Installation of monitoring wells and test pits; and
- Collection of surface and subsurface soil samples and groundwater samples.

POTENTIAL SITE CONTAMINANTS: Diesel, fuel oil, 2,4- dinitrotoluene and 2,6- dinitrotoluene (2,4- and 2,6-DNT), nitroglycerin, polycyclic aromatic hydrocarbons (PAHs), perchlorates, lead, and arsenic.

ROUTES OF ENTRY: Inhalation of vapors and dust; skin contact with soil, free product, or groundwater; and incidental ingestion of soil or groundwater.

PROTECTIVE MEASURES: Engineering controls, safety glasses, safety boots, hardhat, gloves, protective clothing, respirators, and participation in a hazard communication (HAZCOM) program discussing potential physical and chemical hazards associated with explosives.

MONITORING EQUIPMENT: Photoionization Detector (PID).

4.3 Introduction

4.3.1 Purpose and Regulatory Compliance

This site-specific Health and Safety Plan (H&S Plan) addresses procedures to minimize the risk of chemical exposures, physical accidents to on-site workers,

and environmental contamination. The H&S Plan covers each of the 11 required plan elements as specified in 29 CFR 1910.120 or equivalent state regulations. Table 4-1 lists the sections of this plan, which apply to each of these required elements. When used together with Aspect Consulting LLC's Corporate H&S Program Manual, this site-specific plan meets all applicable regulatory requirements.

This H&S Plan was developed by Hart Crowser for protection of its employees working on the project site. Aspect Consulting or other firms working on the project may use this plan while working on the site, but Hart Crowser will not be held liable for accidents or injuries that occur to third party personnel while using this plan. It is the responsibility of the employer to ensure their workers are adequately protected. Aspect Consulting may develop its own site-specific Health and Safety Plan to protect its employees during implementation of this Work Plan.

Table 4-1 - Location of Required Health and Safety Plan Elements in This Site-Specific H&S Plan

Required H&S Plan Element	Section in this Health and Safety Plan
Confined space entry	4.4.6 Other Physical Hazards
Decontamination	4.9 Decontamination
Emergency response plan	4.13 Emergency Response Plan
Medical surveillance	4.14 Medical Surveillance
Monitoring program	4.4.3 Air Monitoring and Action Levels
Names of key personnel	4.3.3 Chain of Command
Personal protective equipment	4.5 Protective Equipment, 4.6 Safety Equipment List
Safety and hazard analysis	4.4 Hazard Evaluation and Control Measures
Site control	4.7 Exclusion Areas, 4.11 Site Security and Control
Spill containment	4.12 Spill Containment
Training	4.15 Training Requirements

4.3.2 Distribution and Approval

This H&S Plan will be made available to all Aspect Consulting personnel involved in field work on this project. It will also be made available to

subcontractors and other non-employees who may need to work on the site. For non-employees, it must be made clear that the plan represents minimum safety procedures and that they are responsible for their own safety while present on site. The plan has been approved by the Aspect Consulting Corporate Health and Safety (H&S) Manager. By signing the documentation form provided with this plan (Table 4-5 located at the end of plan), project workers also certify their approval and agreement to comply with the plan.

4.3.3 Chain of Command

The chain of command for health and safety on this project involves the following individuals:

Project Manager: Steve Germiat

The Project Manager has overall responsibility for the successful outcome of the project. The Project Manager, in consultation with the Corporate H&S Manager, makes final decisions regarding questions concerning the implementation of the site-specific H&S Plan. The Project Managers may delegate this authority and responsibility to the Project and/or Field H&S Managers.

Corporate H&S Manager: Steve Germiat

The Aspect Consulting Corporate H&S Manager has overall responsibility for preparation and modification of this H&S Plan. In the event that health and safety issues arise during site operations, she will attempt to resolve them in discussion with the appropriate members of the project team.

Project H&S Manager: Mike Ehlebracht

The Project H&S Manager has overall responsibility for health and safety on this project. This individual ensures that everyone working on this project understands this H&S Plan. This individual will maintain liaison with the Aspect Consulting Project Manager so that all relevant health and safety issues are communicated effectively to project workers.

Field H&S Manager: Bob Hanford

The Field H&S Manager is responsible for implementing this H&S Plan in the field. This individual also observes subcontractors to verify that they are following these procedures, at a minimum. The Field H&S Manager will also assure that proper protective equipment is available and used in the correct

manner, decontamination activities are carried out properly, and that employees have knowledge of the local emergency medical system should it be necessary.

4.3.4 Site Work Activities

The following work tasks will be accomplished:

- Pre-sampling explosives clearing program;
- The installation of monitoring wells and test pits; and
- The collection of surface and subsurface soil samples and groundwater samples.

The expected time frame of this project is June 2004 through June 2005.

4.3.5 Site Description

The approximately 1,625-acre subject property is located east of Tilley Road approximately 2 miles east of Maytown (Figure 4-1). The property is generally flat, with hillsides located on the northern and southern edges. The majority of the property is undeveloped and covered by brush and woodlands. Beaver Creek, running east to west along the southern end of the property, is surrounded by wetlands. A smaller creek (Allen Creek) drains the northwest portion of the property.

A small portion of the property was occupied by a dynamite manufacturing plant from the early 1940s until 1968. For the majority of its operational history (approximately 1942 through 1964), the former Pacific Powder plant (Powder Plant) was limited to the northcentral portion of the site and consisted of less than 100 acres of land and leased magazine space from adjacent property owners. In 1965, the Hercules Powder Company (Hercules) purchased approximately 1,600 acres of land surrounding the plant. However, manufacturing activities remained limited to the northcentral 100-acre portion of the property. From approximately 1970 until 1994, Ammonium Nitrate Fuel Oil (ANFO - a mixture of ammonium nitrate and fuel oil) and slurry explosives were manufactured within the Powder Plant and Monoethanolamine Nitrate (MEAN) plant areas. A culvert production facility (Culvert Plant) located west of the Powder Plant Area operated from the early 1970s through the mid-1980s.

4.4 Hazard Evaluation and Control Measures

4.4.1 Toxicity of Chemicals of Concern

Based on previous site information and knowledge of the types of activities conducted at this location, the following chemicals may be present at this site: diesel fuel, oil, 2,4- and 2,6-DNT, nitroglycerin, polycyclic aromatic hydrocarbons (PAHs), perchlorate, lead, and arsenic.

Health hazards of these chemicals are discussed below. This information covers potential toxic effects, which might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from the planned site activities. In general, the chemicals, which may be encountered at this site, are not expected to be present at concentrations that could produce significant exposures. The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures at this site.

These standards are presented using the following abbreviations:

PEL Permissible exposure limit.

TWA Time-weighted average exposure limit for any 8-hour work shift.

STEL Short-term exposure limit expressed as a 15-minute time-weighted average and not to be exceeded at any time during a workday.

Diesel Fuel

Diesel fuel (Diesel Fuel Number 2) consists primarily of straight-chain hydrocarbons from C-10 to C-23. The most abundant constituents are typically C-16 and C-17 hydrocarbons. Some aromatics may also be present, typically contributing less than 0.1 percent of the total product. Exposure to diesel fuel liquid product may produce skin irritation, and inhalation of the product mist may result in headache, nausea, and confusion. Diesel fuel has not been assigned a PEL-TWA. It is not considered a carcinogen by IARC.

Fuel Oil

Fuel oil is a generic term for several types of petroleum products typically used for home or commercial heating, pot burners, stoves, furnaces, etc. They are similar to diesel fuel and kerosene. They are not as hazardous as gasoline from

inhalation of the vapors, but nevertheless may cause similar effects, including central nervous system (CNS) depression in acute exposures, such as during tank cleaning. They can be expected to typically act as a CNS depressant, resulting in slurred speech and mental confusion. No PEL has been established for heating oils. They are a serious aspiration hazard. These products may contain substances, which have been found to cause cancer among lab animals.

2,4-Dinitrotoluene (2,4-DNT)

2,4-Dinitrotoluene (2,4-DNT) is a nitroaromatic compound present as an impurity in TNT and as the main component of military grade DNT. The latter compound is used as a military propellant and ordnance material. Exposure to 2,4-DNT may be expected to occur via the skin or through accidental ingestion or inhalation of contaminated soils or other debris. Toxic effects of overexposure include the induction of methemoglobin formation, which reduces the oxygen carrying capacity of the blood. Animal studies have also reported toxic effects to the liver, kidney, and nervous systems. The EPA classifies 2,4-DNT as a Class B2, or probable, human carcinogen. The current PEL-TWA for dinitrotoluene is 1.5 mg/m³.

Two studies currently document the potentially carcinogenic effects of 2,4-DNT in rats and mice. One study (NCI 1978) reports benign tumors in rats, with no evidence of treatment-related carcinomas seen in either mice or rats. Ellis et al. (1979) reported a significant increase over controls in the incidence of hepatocellular carcinomas and hepatic neoplastic nodules in rats following administration of technical grade 2,4-DNT (t-2,4-DNT) in the diet for two years. In general, it appears that t-2,4-DNT is a potential carcinogen in mammalian systems, although metabolic activation may be required. Technical grade 2,4-DNT, however, contains 2,6-DNT as an impurity. The potency attributable to 2,4-DNT may be in part attributable to 2,6-DNT, a potent hepatocarcinogen (Etnier 1987).

EPA (1986a) and EPA (1991a) have classified 2,4-DNT as a probable human carcinogen (Group B2) and have assigned an oral potency slope of 0.68 (mg/kg-day)⁻¹ (EPA 1991a). However, Etnier (1987) has argued that most of the carcinogenicity attributed to 2,4-DNT is in fact due to 2,6-DNT, that carcinogenesis associated with 2,4-DNT has been inadequately quantified, and that pure 2,4-DNT does not appear to be carcinogenic. Based on these data, 2,4-DNT may be more appropriately designated as Group D (non-classified), with an upperbound potency slope of 0.19 (mg/kg-day)⁻¹. For the purposes of the present plan the more conservative potency slope of 0.683 (mg/kg-day)⁻¹

was used for this isomer. This value has been accepted by EPA and is reported for inclusion in the IRIS.

2,4-DNT is efficiently absorbed from the mammalian gastrointestinal tract. Etnier (1987) and ATSDR (1989a) reports 80 to 90 percent absorption of 2,4-DNT within 24 hours following oral administration to rats, although it is not known whether this compound is more efficiently absorbed from food than from drinking water. Etnier (1987) also reports efficient absorption following inhalation of 2,4-DNT.

2,6-Dinitrotoluene (2,6-DNT)

2,6-Dinitrotoluene (2,6-DNT) is a nitroaromatic ordnance compound present as a minor constituent in military grade TNT and DNT. Exposure to 2,6-DNT may be expected to occur via the skin or through accidental ingestion or inhalation of contaminated soils or other debris. Toxic effects of overexposure include the induction of methemoglobin formation, which reduces the oxygen carrying capacity of the blood. Other animal studies have also reported toxic effects to the liver, kidney, and nervous systems. The EPA classifies 2,6-DNT as a Class B2, or probable, human carcinogen. The current PEL-TWA for dinitrotoluene is 1.5 mg/m³.

EPA (1991a) classifies 2,6-DNT as a probable human carcinogen (Group B2) along with 2,4-DNT, and has assigned an equivalent oral potency value of 0.68 (mg/kg-day)⁻¹. Etnier (1987), however, argues that 2,6-DNT is unquestionably a more potent hepatocarcinogen and estimates an oral carcinogenic potency slope factor of 4.83 (mg/kg-day)⁻¹. While more conservative, this value is supported by available data on the carcinogenicity of this compound to laboratory animals. Ellis et al. (1979) found significant elevations in renal and hepatic tumors in a study with technical grade 2,4-DNT (i.e., a mixture of both 2,4- and 2,6-DNT isomers).

For the purposes of this assessment, the verified potency slope derived by EPA (1991a) for 2,6-DNT was utilized. No inhalation guidelines have been identified for 2,6-DNT, and it was assumed that inhalation exposures would be adequately addressed via the oral slope factor. Therefore, the interim oral carcinogenic potency slope factor (see above) was used to address inhalation exposures as well for the purposes of this plan. 2,6-DNT is efficiently absorbed from the mammalian gastrointestinal tract. Etnier (1987) reports 60 percent absorption of 2,6-DNT within 24 hours following oral administration to rats. It is not known whether this compound is more efficiently absorbed from food than from

drinking water. Etnier (1987) also reports efficient absorption following inhalation of 2,6-DNT.

Nitroglycerin

Nitroglycerine is an ordnance material and is also used medicinally as a vasodilator. Exposure can be expected to occur via accidental ingestion or inhalation or ingestion of soil or other debris. Acute effects in humans are reported to include nausea, vomiting, abdominal cramps, headache, bradycardia, and circulatory collapse. Methemoglobin formation can also result, causing reduced oxygen carrying capacity in the blood. The current PEL-STEL is 0.1 mg/m³.

Nitroglycerine is currently not listed in the IRIS database (EPA 1991a), nor is it listed in the latest HEAST document (EPA 1991b). Sax and Lewis (1989) indicate that toxic effects from nitroglycerine can occur by inhalation, ingestion, or skin absorption. They summarize acute oral lethal dose LD₅₀ values in the rat and mouse of 105 and 115 mg/kg, respectively. They also report the human LD_{LO} by unreported route to be 28 mg/kg. Hercules (1989) report that nitroglycerine is not listed as a carcinogen by the NTP or the IARC; they also report the following effects following occupational exposures above the recommended exposure limit: headache, nausea, vomiting, and fatigue. The current OSHA occupational exposure limit for nitroglycerine is 0.1 mg/m³ reported as a 15-minute STEL. OSHA previously listed an 8-hour exposure limit of 0.05 ppm with a skin absorption notation. Based on the lack of data for nitroglycerine and the similarity of its mode of action with PETN, the present evaluation includes nitroglycerine with PETN in evaluating potential human health risks.

Polycyclic Aromatic Hydrocarbons (PAHs)

Exposure to PAHs can occur via inhalation of vapors, ingestion, and skin and eye contact. Skin contact can result in reddening or corrosion. Ingestion can cause nausea, vomiting, blood pressure fall, abdominal pain, convulsions, and coma. Damage to the CNS can also occur. The U.S. Department of Health and Human Services (1989) has classified 15 PAHs compounds as having sufficient evidence for carcinogenicity, while the EPA (1990) has classified at least 5 of the identified PAHs as human carcinogens. There are no currently assigned PEL-TWA for PAHs, but the closely related material coal tar is listed as coal tar pitch volatiles with a PEL-TWA of 0.2 mg/m³.

Perchlorate

Perchlorate, or perchloric acid, is a colorless, odorless liquid used in analytical chemistry labs, explosives manufacturing, metal plating, and other industrial applications. Exposure to the acid by inhalation causes extreme irritation of the eyes, nose, and throat. In addition, as a respiratory tract irritant, it causes coughing or difficulty breathing. Contact with the acid will burn skin and eyes. Finally, ingestion of perchloric acid will cause burns to the gastrointestinal tract, nausea, and vomiting.

In chronic exposures, the perchlorate anion (ClO_4^-) acts as an inhibitor to iodide uptake by the thyroid, creating symptoms similar to those seen in iodine deficiency, specifically increased thyroid weight and development of goiter. In addition, long-term exposure studies with animals showed higher than expected incidence of abnormalities in hepatic, renal, cardiovascular, and hemopoietic functions. There are currently no federal or state occupational exposure limits for perchloric acid.

Lead

Inorganic Lead. Inorganic lead exposure can occur via inhalation of dusts or metal fumes, ingestion of dusts, and skin and eye contact. The principal target organs of lead toxicity include the nervous system, kidneys, blood, gastrointestinal, and reproductive systems. Generalized symptoms of lead exposure include decreased physical fitness, fatigue, sleep disturbances, headaches, bone and muscle pain, constipation, abdominal pain, and decreased appetite. More severe exposure can result in anemia, severe gastrointestinal disturbance, a "lead-line" on the gums, neurological symptoms, convulsions, and death.

Neurological effects are among the most severe of inorganic lead's toxic effects and vary depending on the age of individual exposed. Effects observed in adults occur primarily in the peripheral nervous system, resulting in nerve destruction and degeneration. Wrist-drop and foot-drop are two characteristic manifestations of this toxicity.

The EPA also currently lists inorganic lead as a Group B2 probable human carcinogen via the oral route. This conclusion is based on feeding studies conducted in laboratory animals. The current PEL-TWA for inorganic lead is 0.05 mg/m^3 . Occupational exposure to lead is also specifically regulated under WAC 296-62-07521, with an action level established at 0.03 mg/m^3 that triggers monitoring and other requirements.

Organo-Lead Compounds. The most notable organo-lead compounds are tetraethyl (TEL) and tetramethyl lead (TML). These chemicals are colorless liquids, which have been used principally as anti-knock compounds in gasoline. When used as such, they are generally mixed with soluble dyes for identification purposes. In the environment, TEL is reported to decompose under sunlight to form crystals of mono-, di-, and triethyl lead compounds, which have a characteristic garlic-like odor.

TEL and TML can be toxic via inhalation, ingestion, percutaneous absorption, and skin and eye contact. Major target organs include the kidneys and the nervous, gastrointestinal, and cardiovascular systems. TEL is irritating to the eyes, and its decomposition products may be inhaled as dust, leading to irritation of the upper respiratory tract and convulsive sneezing. The dusts may also cause itching, burning, and redness of eyes and mucous membranes.

TEL and TML are also readily absorbed into the nervous system and are considerably more neurotoxic than inorganic lead. Minor intoxication by TEL or TML can result in nervous excitation, insomnia, and gastrointestinal symptoms. The most notable symptom of TEL poisoning and repeated exposure is encephalopathy (disease of the brain), characterized by symptoms of anxiety, delirium with hallucinations, delusions, convulsions, and acute psychosis. In contrast to inorganic lead intoxication, peripheral nerve damage is not observed. The current PEL-TWA for both TEL and TML is 0.075 mg/m³ as lead.

Arsenic

Arsenic is toxic by inhalation and ingestion of dusts and fumes or by inhalation of arsine gas. Trivalent arsenic compounds are the most toxic to humans, with significant corrosive effects on the skin, eyes, and mucous membranes. Dermatitis also frequently occurs, and skin sensitization and contact dermatitis may result from arsenic trioxide or pentoxide. Trivalent arsenic interacts with a number of sulfhydryl proteins and enzymes, altering their normal biological function. Ingestion of arsenic can result in fever, anorexia, cardiac abnormalities, and neurological damage. Liver injury can accompany chronic exposure. Skin and inhalation exposure to arsenic has been associated with cancer in humans, particularly among workers in the arsenical-pesticide industry or copper smelters.

The EPA currently classifies arsenic as a Class A, or confirmed, human carcinogen. Arsine is a highly toxic gaseous arsenical, causing nausea, vomiting, and hemolysis. The current PEL-TWA for organic and inorganic forms of arsenic is 0.01 mg/m³.

4.4.2 Potential Exposure Routes

Inhalation

Exposure via this route could occur if volatile chemicals become airborne during site activities, especially upon exposure to open air, warm temperatures, and sunlight. This release of vapors may occur during sampling or excavation activities. Inhalation of dusts contaminated with site chemicals is also a possibility. Air monitoring and control measures specified in this plan will minimize the possibility for inhalation of site contaminants.

Skin Contact

Exposure via this route could occur if contaminated soil, water or product contacts the skin or clothing. Dusts generated during soil movement may also settle on exposed skin and clothing of site workers. Protective clothing and decontamination activities specified in this plan will minimize the potential for skin contact with the contaminants.

Ingestion

Exposure via this route could occur if individuals eat, drink or perform other hand-to-mouth contact in the contaminated (exclusion) zones. Decontamination procedures established in this plan will minimize the inadvertent ingestion of contaminants.

4.4.3 Air Monitoring and Action Levels

As shown in Table 4-2, air monitoring will be conducted to determine possible hazardous conditions and to confirm the adequacy of personal protective equipment. The results of the air monitoring will be used as the basis for specifying personal protective equipment and determining the need to upgrade protective measures.

The specific monitoring equipment item(s) to be used on this project will be indicated by Unit Number on the project Field Equipment & Supplies form. This form is included in this plan by reference. The Unit Number ties each specific piece of equipment to the records maintained in the Equipment Log Books by the Equipment Technician. As detailed below, calibration, maintenance, and repair activities are performed or arranged for each air monitoring equipment item by the Equipment Technician. These activities are conducted at the frequency specified by the manufacturer or more frequently as required by use

conditions, and all such calibration/repair records are documented in the Equipment Log Books by the Equipment Technician.

Table 4-2 - Air Monitoring Action Levels

Monitoring, Device	Result	Action Required	Notes
HNU PI 101	5 to 10 Units above Background	Use Half-Mask Respirator	a,b
	10 to 100 Units above Background	Use Full-Face Respirator	a,b
	>100 Units above Background	Stop Work; Contact Project H&S Manager	a,b

Notes:

a. Use appropriate lamp and calibrate unit.

b. Air-purifying respirators must be used only when use criteria are met and when appropriate cartridges are available.

Air monitoring will generally be conducted by the Field Health and Safety Manager or other designated individual. The Project Manager is responsible for ascertaining that each designated operator is properly trained in the use of the monitoring equipment. The results of all air monitoring will be recorded on the project Field Health and Safety Report and will be used as the basis for specifying personnel protective equipment and determining the need to upgrade/downgrade protective measures. When completed, these data reports will be filed with the project records.

The following sections describe the types of monitoring equipment, which are available for use on projects. Monitoring procedures and calibration/maintenance are discussed separately for each equipment item.

Photoionization Detector

The Photoionization Detector (PID) will be used when volatile organic chemicals may be present during site activities at unacceptable concentrations. This detector is non-specific, meaning that it does not identify the chemicals present. In addition, since it is calibrated using only a single reference chemical, the PID provides only an estimate of the actual vapor concentration present. If chemical-specific information is necessary, this device must be backed up with other types of sampling equipment.

Monitoring Procedures. Where applicable, air monitoring will be conducted with a HNU PI 101, or equivalent, with 10.2 or 11.7 eV lamp, to measure organic vapor concentrations during site work activities.

The 10.2 eV lamp will be specified for general hydrocarbon survey measurements for chemicals having an ionization potential below 10.2 eV.

The Field Health and Safety Manager or other designated project individual is responsible for verifying that the equipment is calibrated and working properly before on-site use. For the HNU, this will include zeroing the instrument prior to start of work. Records of these activities will be maintained in the Field Health and Safety Report. If there are any problems with the equipment, the item will be removed from use until repair or replacement can be coordinated with the Equipment Technician.

Action Levels. HNU monitoring will be conducted prior to the start of work at each individual work area where volatile chemicals may be present.

- **If HNU measurements are less than 5 HNU units above ambient background levels**, work can proceed without respiratory protection. In this case, monitoring will be repeated at 15- to 30-minute intervals, or more frequently, if odors or signs of irritation are noted.
- **If HNU measurements are between 5 and 100 HNU units above ambient background** levels in the worker's breathing zones for five consecutive minutes, then site workers exposed to these levels will use air purifying respirators as specified in Table 4-2. Repeat monitoring at least every 15 minutes, or sooner, if any odors or signs of irritation are noted.
- **If HNU measurements exceed 100 HNU units** in employee breathing zones, site work will cease and employees will evacuate the work area pending re-evaluation of the situation by the Corporate H&S Manager. Action will be taken, including plan modification, if required, to address any situations where such results are observed.

Calibration and Maintenance. Calibration and maintenance of the HNU (or equivalent) monitor will be accomplished as follows.

All HNU monitors returned to the Equipment Room will be accompanied with a completed Notice of Returned Equipment form, indicating the equipment condition. The Equipment Technician will perform maintenance/repair as required to correct any problems indicated on this form. Each time an HNU monitor is returned to the office, the Equipment Technician will check the probe connector pins for damage, verify that the selector switch is operating properly, and ensure that the unit is properly charged. As recommended by the manufacturer, cleanliness of the 10.2 eV lamp will be verified by checking for a negative needle deflection on exposure to water vapor. Any repairs will be documented in the Equipment Log Book. Each HNU currently in service will be calibrated using isobutylene calibration gas cylinder and regulator as

recommended by the manufacturer. Actual calibration gases may be purchased from local vendors. Calibration will consist of a response check and instrument adjustment using a 100 ppm isobutylene standard. Calibration will be performed at least weekly, or more frequent if required by specific project needs. Calibration results will be documented in the Equipment Log Book.

4.4.4 Fire and Explosion Hazard

No fire hazards are expected on site. An ABC dry chemical fire extinguisher with a minimum charge of 10 pounds shall be a part of the sampling equipment brought to the site. If flammable chemical products are encountered as a separate phase or as vapors, constant attention to readings obtained from the combustible gas indicator (MSA 361 or equivalent) will be necessary to avoid exceeding the lower explosive limit. Observe basic precautions such as no smoking or creation of sparks or open flames.

The primary energetic and explosive (E&E) constituents manufactured or used at the facility include nitrocellulose (NC), nitroglycerin (NG), ammonium perchlorate (AP), sodium perchlorate, monoethanolamine nitrate (MEAN), ammonia nitrate fuel oil (ANFO), and possibly 2,4,6-trinitrotoluene (TNT - not currently identified as a constituent of potential concern but was often used in the production of dynamite). Blasting caps have also been used at the site. They are small cylindrical objects commonly attached to wires. They contain small, very sensitized charges of primary explosives enclosed in a watertight container. Boosters, small charges of sensitive E&E materials intended to detonate large charges, were not known to be manufactured at the site but were found in the MEAN Plant sump (Titan 25 boosters which consisted of 4.5-inch-long metal cased tubes). It is not known why they were present and disposed of within the sump but the potential to encounter additional boosters is a potential hazard. More detailed physical descriptions of E&E materials are provided in the Explosive Hazard Assessment (EHA) included in Appendix C.

Prior to beginning field work, field staff and project managers will attend a hazard communication (HAZCOM) program presented by a qualified explosives expert as well as the Aspect Consulting corporate health and safety manager. The HAZCOM program will discuss the chemical and physical hazards and general appearance of E&E constituents that could be encountered at the site.

In areas where nitroglycerin was produced and handled within the Old and New Nitrator Areas (e.g., Nitrator Houses, Neutralizer House, Mix House, Nitrocotton House, Acid Pond, and Spent Acid Batch House), a preventative explosive clearing program will also be performed to minimize potential safety hazards

during implementation of the RI/FS sampling program (see EHA in Appendix C). The preventative explosive clearing program will be performed by qualified explosives experts in a manner that will minimize uncontrolled releases of potentially impacted soils and decrease the potential of field sampling personnel from encountering unsafe working conditions.

Task-specific safety plans have been developed for field personnel when conducting intrusive activities in close proximity to former E&E process equipment, manufacturing operations, or disposal areas. These task-specific safety plans are provided in Appendix C.

4.4.5 Heat and Cold Stress

Use of impermeable clothing reduces the cooling ability of the body due to evaporation reduction. This may lead to heat stress. Cold stress, or hypothermia, can result from abnormal cooling of the core body temperature.

Signs of Heat Stress

"Heat stress" is a term that is used to describe progressively more serious symptoms, as follows:

- An initial rise in skin temperature due to increased blood flow to the skin (skin redness);
- Increase in heart rate, to more than 30 beats/minute above the resting level;
- Collapse, or heat exhaustion, due to inadequate blood flow to the brain;
- Dehydration, due to excessive sweating;
- Hyperventilation, resulting in a reduction of the normal blood carbon dioxide concentrations;
- Tingling around the lips, dizziness, cramping of muscles of hands and feet, and blackout; and finally
- "Heat stroke," characterized by unconsciousness, hot dry skin, and absence of sweating.

Control of Heat Stress

On hot, sunny days (high radiant heat load), if using impermeable work clothing, maintain appropriate work-rest cycles (progressively longer rest breaks in a cool location or the shade as temperature and work tasks increase) and drink water or electrolyte-rich fluids (Gatorade or equivalent) to minimize heat stress effects. Impermeable clothing will only be worn when absolutely necessary for control of hazardous chemicals.

Also, when ambient temperatures exceed 70° F, employees will conduct monitoring of their heart (pulse) rates, as follows:

- Each employee will check his or her own pulse rate at the beginning of each break period;
- Take the pulse at the wrist for 6 seconds, and multiply by 10; and
- If the pulse rate exceeds 110 beats per minute, then reduce the length of the next work period by one-third.

Example: After a one-hour work period at 80 degrees, a worker has a pulse rate of 120 beats per minute. The worker must therefore shorten the next work period by one-third, resulting in a work period of 40 minutes until the next break.

Treatment of Heat Stress

Individuals affected by mild forms of heat stress (heat exhaustion, dehydration, or cramping) should take a break in a cool or shaded location, drink liquids, and sit or lay down until feeling better. Shorter work periods should be used until temperature cools off.

Individuals affected by heat stroke are in critical condition. Summon emergency aid immediately, remove clothing, and bathe individual in cool water continually to bring down body temperature.

Signs of Hypothermia

Hypothermia can result from abnormal cooling of the core body temperature. It is caused by exposure to a cold environment, and wind-chill as well as wetness or water immersion can play a significant role. The following discusses signs and symptoms as well as treatment for hypothermia.

Typical warning signs of hypothermia include fatigue, weakness, incoordination, apathy, and drowsiness. A confused state is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink. Body temperatures below 90° F require immediate treatment to restore temperature to normal.

Treatment of Hypothermia

Current medical practice recommends slow rewarming as treatment for hypothermia, followed by professional medical care. This can be accomplished by moving the person into a sheltered area and wrapping with blankets in a

warm room. In emergency situations where body temperature falls below 90° F and heated shelter is not available, use a sleeping bag, blankets, and/or body heat from another individual to help restore normal body temperature.

4.4.6 Other Physical Hazards

Trips/Falls

As with all field work sites, caution will be exercised to prevent slips on rain slick surfaces, stepping on sharp objects, etc. Work will not be performed on elevated platforms without fall protection. All excavations will be temporarily enclosed during work with barrier tape, or similar measures will be used to prevent workers from accidentally falling into an excavation.

Confined Spaces

Confined space entry is not anticipated for this project. Personnel will not enter any confined space, such as excavations, tanks, or trenches, without specific approval of the Project Manager and Corporate H&S Manager. In addition, no entry into a confined space will be attempted until the atmosphere of the confined space is properly tested and documented by the Field H&S Manager or designated representative and a self-contained breathing apparatus is available on site. A confined space entry permit must also be issued and followed. All specified precautions must be carefully followed, including upgrading of personal protective equipment as directed by the Field H&S Manager or designated representative.

Noise

Appropriate hearing protection (ear muffs or ear plugs with a noise reduction rating of at least 25 dB) will be used for individuals working near an active drill rig or other high-noise generating equipment.

4.4.7 Hazard Analysis and Applicable Safety Procedures by Task

The work tasks and associated hazards, which may be anticipated during the operations described elsewhere in this work plan, and suitable control measures are presented in Table 4-3.

Table 4-3 - Hazard Analysis by Task

Work Task	Hazards	Protective Measures ^{a,b}
Site reconnaissance	None anticipated	Level D PPE
Installation of monitoring wells and excavation of test pits	Splashes, skin contact, moving equipment, inhalation, fire/explosion risk	Level C PPE, caution around moving equipment, air monitoring
Sample collection	Splashes, skin contact, inhalation	Level C PPE

^aProtection levels are defined in Table 4-4. Level C is typically modified to include respiratory protection only as warranted by contaminants.

^bProtection levels may require upgrade based on site monitoring or other information.

In addition, special task requirements include the following.

Drilling/Excavations

Drilling activities will be conducted with appropriate splash protection as discussed under personnel protective equipment requirements. Noise protection must also be available and used whenever drilling activities are in progress. In addition, exclusion zones will be established for worker protection as discussed below.

Excavation will be accomplished with similar precautions and employees will be cautioned to stand clear of all equipment and open excavations. Employees will not enter any excavations of 3 feet or greater depth without proper shoring or sloping.

Soil and Groundwater Sampling

All soil and groundwater sampling activities will be conducted under the assumption that the media is contaminated and appropriate personal protective equipment will be required.

4.5 Personal Protective Equipment (PPE)

Table 4-4 presents a summary of minimum personal protective equipment requirements based on the potential route of contact and the potential contaminants. These requirements are classified in the designated Level D and C categories as discussed below. In this plan, Level C is presented as a modified protection level, incorporating respiratory protection only where required by site conditions or as specified under the previous discussion of drums. Situations requiring Level A or B protection are not anticipated for this project. As noted

previously, should they occur, work will stop and the H&S Plan will be amended as required prior to resuming work.

4.5.1 Level D Activities

Workers performing general site activities where skin contact with free product or contaminated materials is not likely and inhalation risks are not expected will wear regular work clothes or regular or polyethylene-coated Tyvek®, eye protection, hard hat (as required), nitrile or neoprene-coated work gloves (as required), and safety boots.

4.5.2 Level C Activities

Workers performing site activities where skin contact with free product or contaminated materials is possible will wear chemical-resistant gloves (nitrile, neoprene, or other appropriate outer gloves, surgical inner gloves) and polyethylene-coated Tyvek® or other chemical-resistant suits or rain gear. Make sure the protective clothing and gloves are suitable for the types of chemicals that may be encountered on site. Use face shields or goggles as necessary to avoid splashes in the eyes or face.

Table 4-4 - Minimum Personal Protective Equipment Level Requirements

Potential Route of Contact: Types of Contaminants	Required Protection Level	Required Equipment								
		Safety Glasses	Hard Hat	Safety Boots	Tyvek	Poly Tyvek	Nitrile Gloves	Neoprene Gloves	Respirator	
									Half-Face	Full-Face
None Anticipated	Level D(a)	X	b	X						
Minor Skin Contact Possible	Level D(a)	X	b	X	X		X			
Skin Contamination Possible:	Level C(c)									
Acids		d	b	c		X		X		
Bases		d	b	c		X		X		
Inorganics		X	b	c		X		X		
Organics		X	b	c		X	X			
Inhalation Possible	Level C(c)									
Organics		X	b	c	X		X		f,g	f,h
Acids		d	b	c	X			X	f,g	f,h
Bases		d	b	c	X			X	f,g	f,h
Organics		X	b	c	X		X		f,a	f,h

Notes:

- Level D protection required when atmosphere contains no known hazard and work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.
- Hard hat is required where risk of striking overhead or falling objects exists.
- Level C protection required when the atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin; the types of air contaminants have been identified, concentrations measured, an appropriate respirator cartridge is available; and all air-purifying respirator criteria are met.
- Goggles, face-shield, or full-face respirator required.
- Chemical-resistant synthetic boots required.
- Appropriate respirator cartridges include: organic vapor (MSA GMA or equivalent), combination (MSA GMC-H or equivalent), and others as required by contaminants.
- Half-face respirator required when HNU concentrations range from 5 to 10.
- Full-face respirator required when HNU concentrations range from 10 to 100 and/or eye irritation occurs.

When performing activities in which inhalation of chemical vapors and dusts is a concern, wear half-mask or full-face air-purifying respirators as specified in Table 4-4. If respirators are used, cartridges should be changed on a daily basis, at minimum. They should be changed more frequently if chemical vapors are detected inside the respirator or other symptoms of breakthrough are noted (irritation, dizziness, breathing difficulty, etc.).

4.6 Safety Equipment List

The following Safety Equipment must be available on site:

- Fire Extinguisher - 10 lb ABC;
- First Aid Kit;
- Eye Wash Kit;

- Mobile Telephone;
- Half-face APR - Organic Vapor/HEPA Cartridge (MSA GMA or equivalent) or Combination Cartridge (MSA GMC-H or equivalent);
- Hard Hat;
- Tyvek® Coveralls;
- PVC (or similar) rainsuit;
- Neoprene Steel-Toed Boots; and
- Nitrile Outer Gloves.

4.7 Exclusion Areas

If migration of chemicals from the work area is a possibility, or as otherwise required by regulations or client specifications, site control will be maintained by establishing clearly identified work zones. These will include the exclusion zone, contaminant reduction zone, and support zone, as discussed below.

4.7.1 Exclusion Zone

Exclusion zones will be established around each hazardous waste activity location. Only persons with appropriate training and authorization from the Field H&S Manager will enter this perimeter while work is being conducted there. Traffic cones, barrier tapes, and warning signs will be used as necessary to establish the zone boundary. Plastic stanchions will be placed as required to prevent unauthorized access to within 10 feet from the side and a minimum of 25 feet behind the rear of any vehicles or open excavations. Danger signs will be posted in plain view of approach from either direction.

4.7.2 Contamination Reduction Zone

A contamination reduction zone will be established just outside each temporary exclusion zone to decontaminate equipment and personnel as discussed below. This zone will be clearly delineated from the exclusion zone and support zone using the means noted above. Care will be taken to prevent the spread of contamination from this area. Drums will be filled with spent decontamination fluids and used protective clothing on a daily basis. The drums, after labeling, will be moved to central storage location(s) on site pending disposal.

4.7.3 Support Zone

A support zone will be established outside the contamination reduction area to stage clean equipment, don protective clothing, take rest breaks, etc. This zone

will be clearly delineated from the contaminant reduction zone using the means noted above.

4.8 Minimization of Contamination

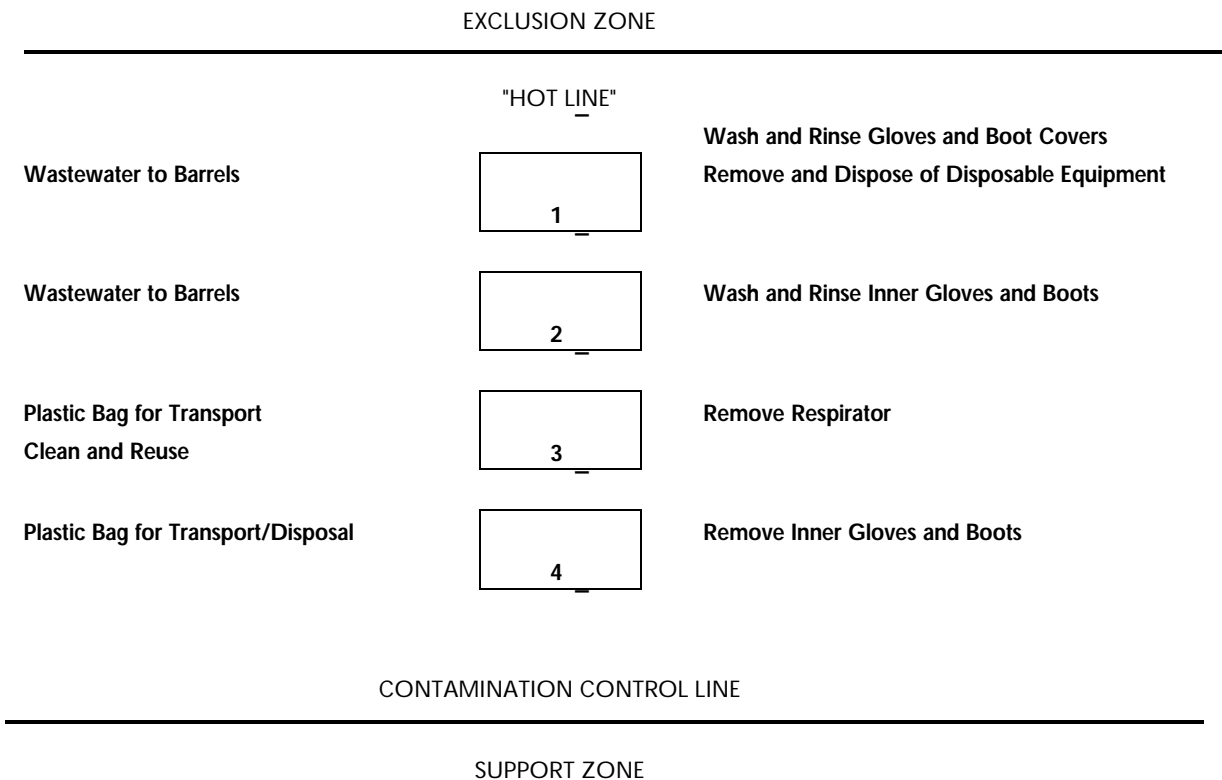
To ensure the work zone procedures function effectively, the amount of equipment and number of personnel allowed in contaminated areas must be minimized. In addition, the amounts of soil, water, or other media collected should not exceed what is needed for laboratory analysis and record samples. Do not kneel on contaminated ground, stir up unnecessary dust, or perform any practice that increases the probability of hand-to-mouth transfer of contaminated materials. Use plastic drop cloths and equipment covers where appropriate. Eating, drinking, chewing gum, smoking, or using smokeless tobacco are forbidden in the exclusion zone.

4.9 Decontamination

Decontamination is necessary to limit the migration of contaminants from the work zone(s) onto the site or from the site into the surrounding environment. Figure 4-2 presents a layout for conducting decontamination within the sites zones discussed previously. Equipment and personnel decontamination are discussed in the following sections, and the following types of equipment will be available to perform these activities:

- Boot and Glove Wash Bucket and Rinse Bucket;
- Scrub Brushes - Long Handled;
- Spray Rinse Applicator;
- Plastic Garbage Bags; and
- 5-Gallon Container Alkaline Decon Solution.

Figure 4-2 - Decontamination Layout



4.9.1 Equipment Decontamination

Proper decontamination (decon) procedures will be employed to ensure that contaminated materials do not contact individuals and are not spread from the site. These procedures will also ensure that contaminated materials generated during site operations and during decontamination are managed appropriately.

All non-disposable equipment will be decontaminated in the contamination reduction zone. Prior to demobilization, all contaminated portions of heavy equipment should be thoroughly cleaned. Heavy equipment may require steam cleaning. Soil and water sampling instruments should be cleaned with detergent solutions in portable buckets.

4.9.2 Personnel Decontamination

Personnel working in exclusion zones will perform a mini-decontamination in the contamination reduction zone prior to changing respirator cartridges (if worn), taking rest breaks, drinking liquids, etc. They will decontaminate fully before eating lunch or leaving the site. The following describes the procedures for mini-decon and full decon activities.

Mini-decon Procedure

1. In the contamination reduction zone, wash and rinse outer gloves and boots in portable buckets.
2. Inspect protective outer suit, if worn, for severe contamination, rips or tears.
3. If suit is highly contaminated or damaged, full decontamination as outlined below will be performed.
4. Remove outer gloves. Inspect and discard if ripped or damaged.
5. Remove respirator (if worn) and clean off sweat and dirt using premoistened towelettes. Deposit used cartridges in plastic bag.
6. Replace cartridges and outer gloves, and return to work.

Full Decontamination Procedure

1. In the contamination reduction zone, wash and rinse outer gloves and boots in portable buckets.

2. Remove outer gloves and protective suit and deposit in labeled container for disposable clothing.
3. Remove respirator, and place used respirator cartridges (if end of day) in container for disposable clothing.
4. If end of day, thoroughly clean respirator and store properly.
5. Remove inner gloves and discard into labeled container for disposable clothing.
6. Remove work boots without touching exposed surfaces, and put on street shoes. Put boots in individual plastic bag for later reuse.
7. Immediately wash hands and face using clean water and soap.
8. Shower as soon after work shift as possible.

4.10 Disposal of Contaminated Materials

All disposable sampling equipment and materials will be placed inside of two 10 mil polyethylene bags or other appropriate containers and placed in storage as directed by the client. If storage is unavailable on site, or if other hazardous wastes will not be gathered and collected as part of this effort, then disposable supplies will be removed from the site with the personnel.

4.11 Site Security and Control

Site security and control will be the responsibility of the Project Manager. The "buddy-system" will be used when working in designated hazardous areas. Any security or control problems will be reported to appropriate authorities.

4.12 Spill Containment

Sources of bulk chemicals subject to spillage are not expected to be encountered in this project. Accordingly, spill containment plan is not required for this project.

4.13 Emergency Response Plan

The Aspect Consulting Emergency Response Plan outlines the steps necessary for appropriate response to emergency situations. The following paragraphs summarize the key Emergency Response Plan procedures for this project.

4.13.1 Plan Content and Review

The principal hazards addressed by the Emergency Response Plan include the following: fire or explosion, medical emergencies, uncontrolled contaminant release, and situations such as the presence of chemicals above exposure guidelines or inadequate protective equipment for the hazards present. However, in order to help anticipate potential emergency situations, field personnel shall always exercise caution and look for signs of potentially hazardous situations, including the following as examples:

- Visible or odorous chemical contaminants;
- Drums or other containers;
- General physical hazards (traffic, moving equipment, sharp or hot surfaces, slippery or uneven surfaces, etc.);
- Possible sources of radiation;
- Live electrical wires or equipment;
- Underground pipelines or cables; and
- Poisonous plants or dangerous animals.

These and other potential problems should be anticipated and steps taken to avert problems before they occur.

The Emergency Response Plan shall be reviewed and rehearsed, as necessary, during the on-site health and safety briefing. This ensures that all personnel will know what their duties shall be if an actual emergency occurs.

4.13.2 Plan Implementation

The Field H&S Manager shall act as the lead individual in the event of an emergency situation and evaluate the situation. He/she will determine the need to implement the emergency procedures, in concert with other resource personnel including client representatives, the Project Manager, and the Corporate H&S Manager. Other on-site field personnel will assist the Field H&S Manager as required during the emergency.

In the event that the Emergency Response Plan is implemented, the Field H&S Manager or designee is responsible for alerting all personnel at the affected area by use of a signal device (such as a hand-held air horn) or visual or shouted instructions, as appropriate.

Emergency evacuation routes and safe assembly areas shall be identified and discussed in the on-site health and safety briefing, as appropriate. The buddy system will be employed during evacuation to ensure safe escape, and the Field H&S Manager shall be responsible for roll call to account for all personnel.

4.13.3 Emergency Response Contacts

Site personnel must know whom to notify in the event of Emergency Response Plan implementation. The following information will be readily available at the site in a location known to all workers:

- Emergency Telephone Numbers: see list at the beginning of this plan;
- Route to Nearest Hospital: see list and route map on Figure 4-1 at the beginning of this plan;
- Site Descriptions: see the description at the beginning of this plan; and
- If a significant environmental release of contaminants occurs, the federal, state, and local agencies noted in this plan must be immediately notified. If the release to the environment includes navigable waters also notify:
 - National Response Center at (800) 424-8802
 - EPA at (908) 321-6660

In the event of an emergency situation requiring implementation of the Emergency Response Plan (fire or explosion, serious injury, tank leak or other material spill, presence of chemicals above exposure guidelines, inadequate personal protective equipment for the hazards present, etc.), cease all work immediately. Offer whatever assistance is required, but do not enter work areas without proper protective equipment. Workers not needed for immediate assistance will decontaminate per normal procedures (if possible) and leave the work area, pending approval by the Field H&S Manager for restart of work. The following general emergency response safety procedures should be followed.

4.13.4 Fires

Aspect Consulting personnel will attempt to control only very small fires. If an explosion appears likely, evacuate the area immediately. If a fire occurs which cannot be controlled with the 10-pound ABC fire extinguisher located in the field equipment, then immediate intervention by the local fire department or other appropriate agency is imperative. Use these steps:

- Evacuate the area to a previously agreed upon, upwind location;
- Contact fire agency identified in the site-specific plan; and
- Inform Project Manager or Field H&S Manager of the situation.

4.13.5 Medical Emergencies

Contact the agency listed in the site-specific plan if a medical emergency occurs. If a worker leaves the site to seek medical attention, another worker should accompany the patient. When in doubt about the severity of an accident or exposure, always seek medical attention as a conservative approach. Notify the Project Manager of the outcome of the medical evaluation as soon as possible. For minor cuts and bruises, an on-site first aid kit will be available.

- If a worker is seriously injured or becomes ill or unconscious, immediately request assistance from the emergency contact sources noted in the site-specific plan. Do not attempt to assist an unconscious worker in an untested or known dangerous confined space without applying confined space entry procedures or without using proper respiratory protection, such as a self contained breathing apparatus (SCBA).
- In the event that a seriously injured person is also heavily contaminated, use clean plastic sheeting to prevent contamination of the inside of the emergency vehicle. Less severely injured individuals may also have their protective clothing carefully removed or cut off before transport to the hospital.

4.13.6 Uncontrolled Contaminant Release

In the event of a tank rupture or other material spill, attempt to stop and contain the flow of material using absorbents, booms, dirt, or other appropriate material. Prevent migration of liquids into streams or other bodies of water by building trenches, dikes, etc. Drum the material for proper disposal or contact a spill removal firm for material cleanup and disposal, as required. Observe all fire and explosion precautions while dealing with spills.

4.13.7 Potentially High Chemical Exposure Situations/Inadequate Protective Equipment

In some emergency situations, workers may encounter localized work area where exposure to previously unidentified chemicals could occur. A similar hazard includes the situation where chemicals are present above permissible exposure levels and/or above the levels suitable for the personal protective equipment at hand on site. If these situations occur, immediately stop work and evacuate the work area. Do not re-enter the area until appropriate help is available and/or appropriate personal protective equipment is obtained. Do not attempt to rescue a downed worker from such areas without employing confined space entry procedures. Professional emergency response assistance (fire department, HAZMAT team, etc.) may be necessary to deal with this type of situation.

4.13.8 Other Emergencies

Depending on the type of project, other emergency scenarios may be important at a specific work site. These scenarios will be considered as part of the site-specific plan and will be discussed during the on-site safety briefing, as required.

4.13.9 Plan Documentation and Review

The Field H&S Manager will notify the Project H&S Manager as soon as possible after the emergency situation has been stabilized. The Project Manager or H&S Manager will notify the appropriate client contacts, and regulatory agencies, if applicable. If an individual is injured, the Field H&S Manager or designate will file a detailed Accident Report with the Corporate H&S Manager within 24 hours.

The Project Manager and the Field, Project, and Corporate H&S Managers will critique the emergency response action following the event. The results of the critique will be used in follow-up training exercises to improve the Emergency Response Plan.

4.14 Medical Surveillance

A medical surveillance program has been instituted for Aspect Consulting employees having exposure to hazardous substances. Exams are given before assignment, annually thereafter, and upon termination. Content of exams is determined by the Occupational Medicine physician in compliance with applicable regulations and is detailed in the General H&S Plan.

Each team member will have undergone a physical examination as noted above to verify that he/she is physically able to use protective equipment, work in hot environments, and not be predisposed to occupationally induced disease. Additional exams may be needed to evaluate specific exposures or unexplainable illness.

4.15 Training Requirements


Aspect Consulting employees who perform site work must understand potential health and safety hazards. All employees potentially exposed to hazardous substances, health hazards, or safety hazards will have completed 40 hours of off-site initial hazardous materials health and safety training or will possess equivalent training by past experience. They will also have a minimum of three days of actual field experience under the direct supervision of a trained supervisor. All employees will have in their possession evidence of completing this training. Employees will also complete annual refresher, supervisor, and other training as required by applicable regulations.

Prior to the start of each work day, the Field H&S Manager will review applicable health and safety issues with all employees and subcontractors working on the site, as appropriate. These briefings will also review the work to be accomplished, with an opportunity for questions to be asked.

4.16 Reporting, Reports, and Documentation

The Field Health and Safety Report (Figure 4-3) will be completed daily by the Aspect Consulting Field Health and Safety Manager or designated individual. In the event that accidents or injuries occur during site work, the Project Manager will be informed, who will notify the client immediately. Aspect Consulting staff and subcontractors on this site will sign the Record of H&S Communication document (Table 4-5), which will be kept on site during work activities and recorded in the project files.

Field Health & Safety Report

 HARTCROWSER	Job No. _____ Date _____ <div style="text-align: center;">S M T W Th F S</div> Arrival Time: _____ Departure Time: _____
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Field Health & Safety Report

Job _____

Location _____

Client _____

Field Representative _____ Project Manager _____

Field H&S Manager _____ Project H&S Manager _____

Names of personnel on site _____

Site Activities _____

Potential Hazards _____

Hazard Control Used _____

Protective Measures Taken _____

Comments of Observations _____

Sketch position of equipment relative to exploration
 Indicate monitoring point(s) and prevailing wind direction

Exploration No. _____

[illegible]

Table 4-5 - Record of Health and Safety Communication

PROJECT NAME: Former Pacific Powder Site		PROJECT NUMBER: 7723-03	
SITE CONTAMINANTS: Diesel, fuel oil, 2,4- dinitrotoluene and 2,6--dinitrotoluene (2,4- and 2,6-DNT), nitroglycerin, polycyclic aromatic hydrocarbons (PAHs), perchlorate, lead, and arsenic.			
PPE REQUIREMENTS (check all that apply): <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div><input checked="" type="checkbox"/> Safety glasses</div> <div><input checked="" type="checkbox"/> Gloves (specify) <u>Nitrile</u></div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div><input checked="" type="checkbox"/> Safety boots</div> <div><input checked="" type="checkbox"/> Clothing (specify) <u>Tyvek</u></div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div><input checked="" type="checkbox"/> Hard hat</div> <div><input checked="" type="checkbox"/> Respirator (specify) <u>Half-face with HEPA/Organic Vapor Cartridge</u></div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div><input type="checkbox"/> Other (specify) _____</div> </div>			
The following personnel have reviewed a copy of the Site-specific Health and Safety Plan. By signing below, these personnel indicate that they have read the plan, including all referenced information, and that they understand the requirements, which are detailed for this project.			
PRINTED NAME	SIGNATURE	PROJECT DUTIES	DATE

***PROJECT MANAGER: PLEASE ROUTE A COPY OF THIS FORM TO THE CORPORATE H&S MANAGER WHEN COMPLETED.**

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